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THE SCIENCE TEACHER

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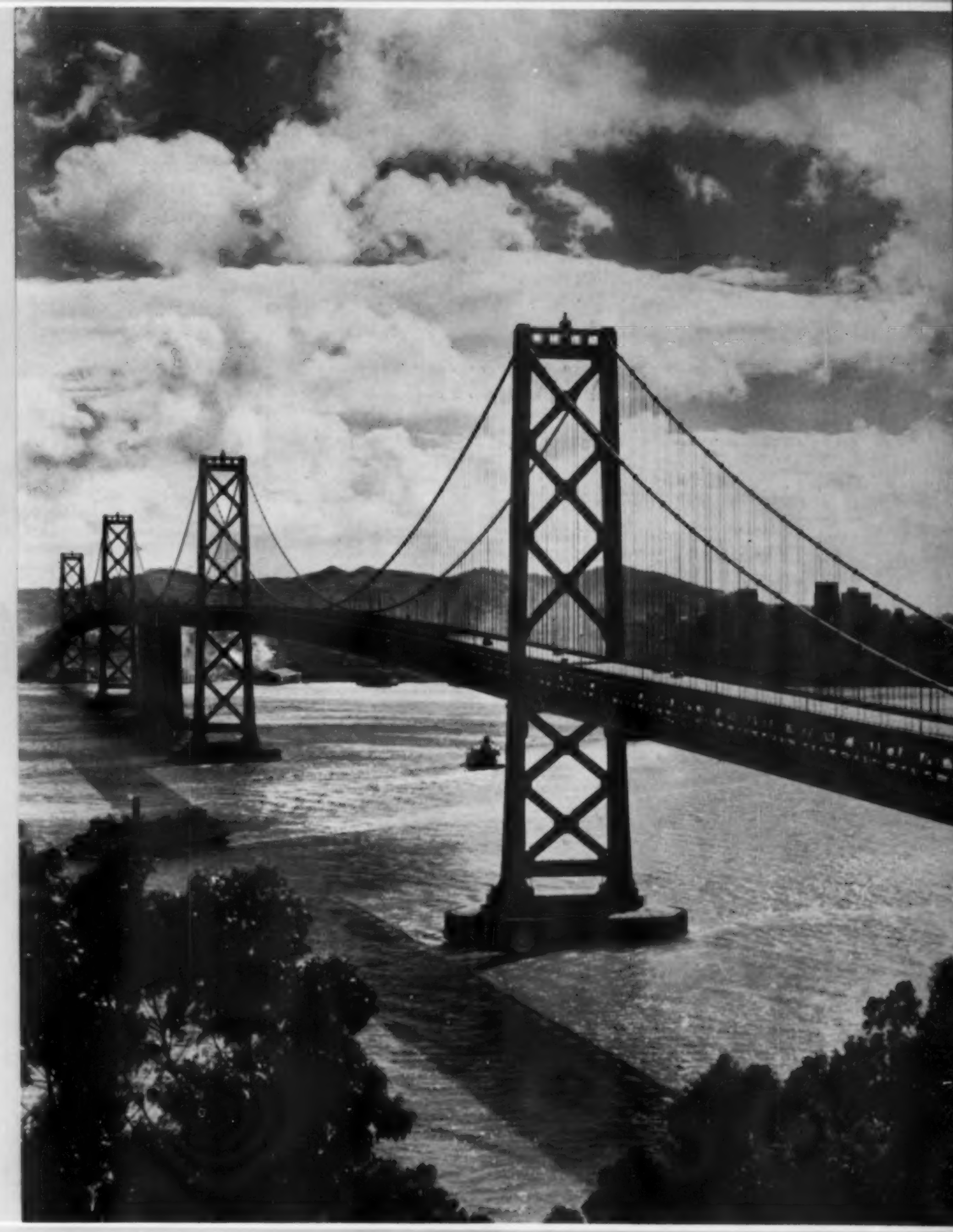
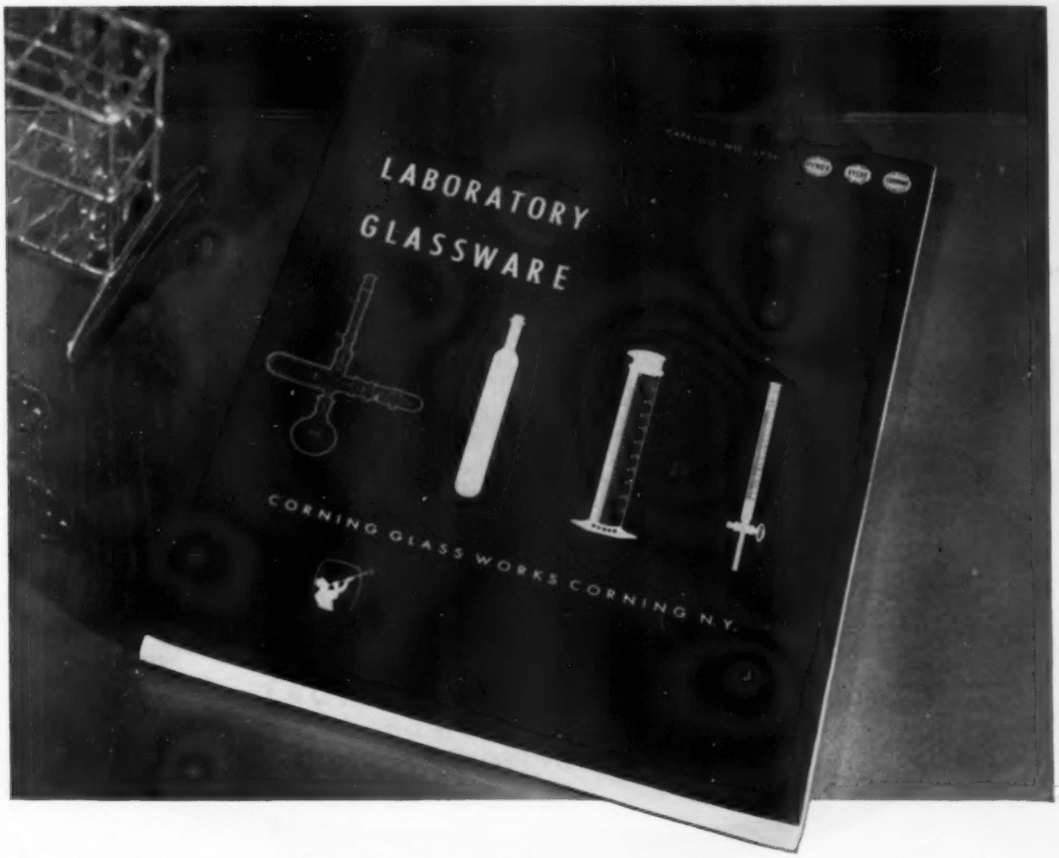


JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION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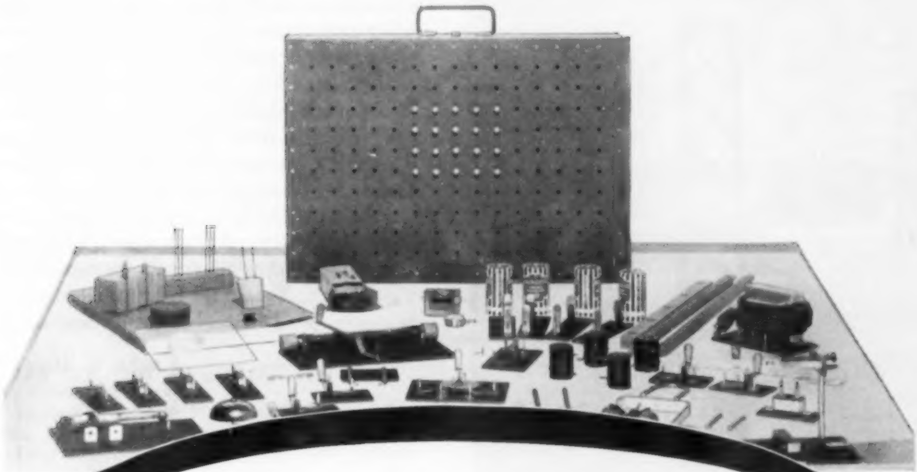

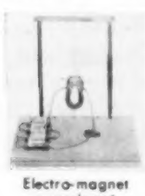

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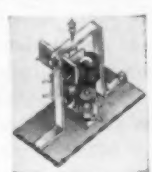

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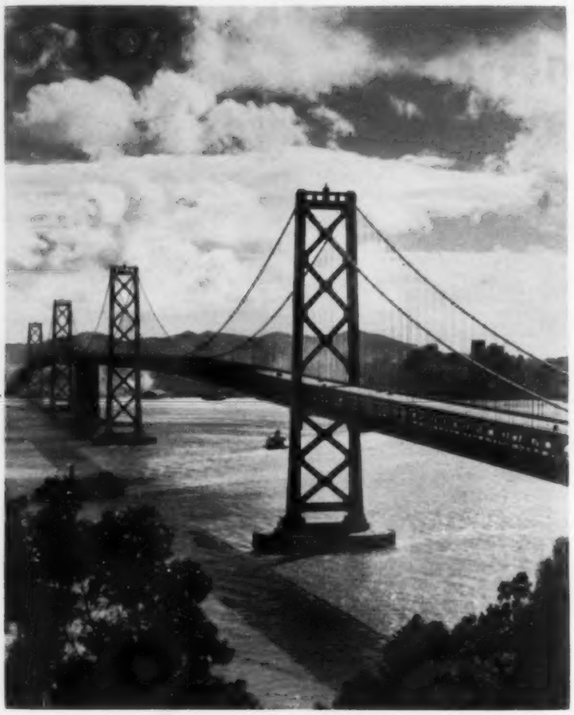

SAN FRANCISCO CONVENTION & TOURIST BUREAU

THIS MONTH'S COVER . . . Yes, this is a view of the San Francisco Bay Bridge taken from Yerba Buena Island. In the distance you see the San Francisco sky line. Many of those attending the NSTA annual winter meeting held in conjunction with AAAS, December 27-29, will be travelling across this span to reach the University of California campus at Berkeley which is the site of the meeting. Berkeley is located in back of us and to the right. See page 295 of NSTA Activities for a synopsis of the program.

Readers' Column

Dr. J. Darrell Barnard
Chairman, NSTA Motion Picture Committee

. . . I am happy to report on our "test showing" of the film excerpt, *The First Atomic Pile*, and to tell you about the reactions of our students.

We showed the film to about sixteen classes in physics and five classes in chemistry. The chemistry students had had physics the year before. All knew about the production of energy by fission.

The students soon realized that this film does not purport to add very much to their knowledge about the subject matter of nuclear energy. However, they were enthusiastic about it and agreed that the film made both the scientific material and the related social problems more real. They felt that it made clear the points stressed in the guide for using the film.

The most discussed point in nearly every class was the moral responsibility of the scientific workers. They had respect and understanding for both points of view (that of the scientists who stayed with the project and that of those who resigned once the pile began to operate, feeling that now it had become a "munitions project").

In some classes we showed it without previous discussion of the film. In others we talked about the film in some detail before seeing it. The best plan seemed to be to show it without previous discussion since all students had the general background, then to have questions and discussion, and finally to show the film once more and discuss it again. Of course, that is generally the case with any teaching film, in my opinion.

The students were much interested in the NSTA project with Teaching Film Custodians and enjoyed being critics. Thank you for letting us do this.

EMILY E. BOGGS
Hunter College High School
New York City

Just a line to let you know that I was greatly impressed by your September issue of *The Science Teacher*. It is not often one picks up a periodical in a special-interest field and finds so much of real importance and general interest.

EDGAR FULLER
Executive Secretary
Council of Chief State School Officers

We are sorry to have to report the death of Dr. Gladys V. Benner late in October. She died of cancer after becoming seriously afflicted during a European tour last summer. Dr. Benner had been a classroom teacher for many years and active in various science education endeavors. At the time of her death she was serving as Special Assistant in Science for the Philadelphia Board of Education. She was a member of the 1953 Harvard Conference that produced the report, *Critical Years Ahead in Science Teaching*. She was also serving on the NSTA Cincinnati Convention committee and was scheduled to be chairman of this year's committee on nominations and elections.

The chairmanship of this committee has been accepted by Dr. Zachariah Subarsky, Chairman of the Department of Biology and General Science, Bronx High School of Science Annex, 2400 Marion Street, Bronx 58, New York. NSTA members who wish to offer suggestions for consideration by the committee should write to Dr. Subarsky at this address. President-elect, secretary, and treasurer and regional directors for Regions I, III, V, and VII are to be elected this year.

THE SCIENCE TEACHER

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MEMBERSHIP

The membership year coincides with the calendar year. New entries during the fall months extend through the following calendar year. Library and elementary school subscriptions coincide with the school year or run for one year from date of entry.

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REMINDER TO *TST* READERS AND SUBSCRIBERS

This is the last issue of Volume XXI and of the calendar year. Publication will be resumed in February 1955.

Editor's Column

This month I must use this column myself—gotta tell you about my travels to the Lake Texoma Conference. Walter Lapp "trained" to Washington on October 8 and we drove to Columbus where we picked up John Richardson. From there the three of us headed west and south to Oklahoma. On a "postman's holiday," we visited several schools en route, explored lead mines in Missouri and Kansas, studied the rocks at road cuts all along the way, and snapped Kodachromes of oil fields, wild flowers, farm ponds, erosion, breeds of cattle, and historic sites and monuments.

In Oklahoma City, Walter Lapp presented awards to 14 students of Webster Junior High School who won prizes and honorable mention in the 1954 ASM-FSAF Science Achievement Awards Program. All three of us sat on the platform at the school's assembly, along with the assistant superintendent of schools, the curriculum director, the principal of the school and the science teachers, and about a dozen scientists from the O. U. Medical School, the Research Institute, and various industrial organizations.

That same afternoon we took part in another assembly to present 23 awards to students this time at Norman, Oklahoma, Junior High School. Ten professors of science from the University of Oklahoma graced the platform and the principal of the Senior High School gave the main address.

Driving down to the Biological Station at Lake Texoma the next day, the chief attraction was the Arbuckle Mountains. Here the geology of sedimentation, mountain building, and erosion is laid bare. Over a distance of 15 to 20 miles the rock formations are up-ended almost 90° from their original positions. You can drive across hundreds of millions of years of geology which (north and south of the Arbuckles) lie buried a mile or more beneath the earth's surface. Congratulations to the Ardmore Lion's Club for the dozens of roadside signs they have erected to tell the story of this unique exposure!

The conference was a big success. "Boss man" Horace H. Bliss (H_2B) and the staff of the Station had food and housekeeping arrangements firmly under control. Wayne Taylor and Advisory Committee provided a program packed with inspiration, information, and "here's how to do its."

Lapp and Richardson flew back home on Sunday. I drove down to Denton, Texas for two days with the Wayne Taylors. The Senior High School there has a beautiful science wing and Wayne promised to tell us about it in a picture story in an early issue of TST. I visited North Texas State Teachers College and Texas State College for Women.

On my way back I made three stopovers in Arkansas, one in Indiana, one in Kentucky, and two in Ohio. One of the Ohio stops was for further planning on the Cincinnati Convention. Hope to see you all there next March 24-26.

Robert H. Carleton

THE SCIENCE TEACHER

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Articles published in THE SCIENCE TEACHER are the expressions of the writers. They are not a statement of policy of the Association or the Magazine Advisory Board.

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

CAN SCIENCE CREATE LIFE?

By WALDEMAR KAEMPFFERT

How does an acorn evolve into an oak or a chicken from an egg? How does the brain think? What are instincts? Just how does a wound heal? What is it in a microbe that makes it split in two again, again, and again, and thus preserve the species indefinitely? Just how do we convert a piece of beefsteak or a glass of milk into tissue and energy?

Such questions are as old as man, and for centuries scientists have been groping for the answers. And when the answers come they will startle us, just as did the explosions of two atomic bombs over Hiroshima and Nagasaki. And we shall be startled, not because of the practical value of the answers, but because of the new control over nature that will be acquired.

What is life? There is no good definition. We know only that an orderly structure, like an egg, produces another but more highly developed structure like a hen. Order creates order in some mysterious way. That is not the way of inanimate matter, like iron or clay.

Growth, reproduction, assimilation of food or stuff of some kind, evolution—these are sometimes characteristics of much lifeless matter, so that it is impossible to rely on them as tests. The best that any scientist can do is to say that life is a "physiochemical relationship." What does he mean? Merely that we are machines which are "alive." Grant that a living creature is a machine, like a steam engine or an automobile, and there is no theoretical reason why it cannot be created not in form but in function in a properly equipped machine shop by very knowing mechanics.

The scientists have been telling us for generations that the universe is running down like a clock, which means that order gives way to disorder. But life is different. It is not immune from what is called the "law of entropy," the law which says that wound clocks inevitably run down, that heat falls from a high to a low place, that energy dissipates itself. Life for a time manages to stave off this "heat death," and to produce order from order. How?

This problem of life is the profoundest that confronts science. Somehow science must link what it has found out about inanimate matter with microbes, birds, and men. We are all composed of atoms—the very atoms that make the sun and the stars shine, the very atoms found in everything on this earth. So why not apply the knowledge gained by tearing bits of gold, iron and uranium apart and thus discover how an embryo comes into being and develops into a man, who can make another embryo which will develop into another man? It sounds not too difficult, and yet science is baffled.

Erwin Schroedinger, Nobel laureate in physics, has applied himself to this problem. To him the way an embryo develops into a man is the most fascinating of all problems in science—far more fascinating than releasing energy from uranium-235 or plutonium. He is amazed at what happens when fruit-fly eggs are bombarded by X rays. Monstrosities devolop—flies with red eyes, flies that are hairy and flies that are naked, flies that have no wings, flies with marked abnormalities. And these flies, if they survive, all breed true, which means that the offspring are just like their parents. Something happened to the invisible genes in the germ plasm of the bombarded flies, the genes being to life what atoms are to a metal or gas.

Now these genes are contained in little packages, which are called chromosomes because they are

Originally published in the New York Times Magazine and included in Waldemar Kaempffert's book EXPLORATIONS IN SCIENCE, published by The Viking Press, New York.

visible under a microscope when they are stained with the right dye. The genes are undoubtedly complex molecules, so that we have to deal with them physically and chemically. The X rays (heat will do it too) upset the molecular structure of the gene, and the new structure gives the germ plasm new potentialities, so that such monstrosities are born.

Yet this does not explain why the chromosomes of a father or a mother—the chromosomes that contain the genes—should neatly divide, so that some features of the father and some of the mother are passed on to children. Nor does it explain why some characteristics are "sex-linked," as the biologists call them, so that the bleeding sickness (hemophilia) and color blindness, though carried by daughters, appear only in sons. Schroedinger has approached this problem mathematically and also from the standpoint of the quantum theory, which explains why atoms in an electric lamp's filament give off light when they are heated by a current.

It seems to him that heat is the explanation—heat that makes molecules move faster and sometimes upsets their structure. He regards the gene as a highly complicated giant molecule, which can reproduce itself. This is a new way of looking at life, a useful way which the biochemist and the biophysicist may find worth pursuing. It is the best approach that we have, because it makes it possible to explain life in terms of the new knowledge.

Yet Schroedinger has to admit that if this orderly complicated molecule, this gene, can produce a much more complicated and orderly horse or man, order must be fed to it from the outside. Otherwise it would be merely an aggregation of atoms which would run down like a clock. And yet where are we when we are presented with this approach to the mystery of life? We find ourselves facing a granite wall which we have not even chipped. The genes and chromosomes contain what Schroedinger calls a "code script," that gives orders which are carried out. And because we can't read the script as yet we know little of growth, little of life.

Scientists have torn micro-organisms and tissues chemically apart. With what results? Wherever there is animal life there is protein. "But protein is what I eat in the form of meat," you say. You are right. Milk, meat, white of egg or albumen, bacteria, viruses, lungs, hearts—you find protein wherever there is life, though all protein is by no means alive.

Protein is built up of a score and more of what are called amino acids. It is no difficult matter to obtain amino acids. But to combine them into protein is far more difficult than was the separation of radium from its ore or the discovery of the outermost planet Pluto. A protein molecule is too small to be seen even in the most powerful microscope. Yet that molecule must be designed. There must be sketches. So the chemist actually draws pictures to show how he thinks that nitrogen, the most important constituent of protein, is hooked to oxygen, carbon, hydrogen, and other elements. Like an architect, he knows which designs are possible and which impossible either because of technical obstacles insurmountable at the moment or because the needed hooks are absent. The divination of genius is required to build up a protein molecule in this way, just as it is required to put the right words together and produce *Hamlet*.

It is safe to say that no good organic chemist denies that ultimately the right designs will be developed and that with them the smooth progression to life will begin. About the first synthetic proteins will be threads and hairs indistinguishable from real wool, silk, cobweb, and fur. Our rayons are merely chemically changed cotton or wood and nothing like the silk of the silkworm. The best that has been done in such reconversions is to make wool out of milk, which involves nothing more than the transformation of existing protein into a thread that can be spun and woven. There is no theoretical reason why meat should not thus be transformed into a dress suit. In fact, it has been done in Germany with fish.

What we want is a thread of real protein made out of the gases of the air, with the aid of coke, limestone, and a few other essentials. A remote approach to that is nylon. Though it would not fool a silkworm, nylon is a first step in solving the problem presented by the synthesis of life, a harbinger of ultimate success which will have a revolutionary effect on industry and science.

Don't think that all this is pure imagination. So skillful are the chemists even now in divining the structure of protein molecules in hair, silk, and fur that they can test their theories. Dr. W. T. Astbury of Leeds, England, has been able to show, for example, that shrunken wool is elastic because the protein molecules are grouped into springs. As much might have been guessed from the way wool shrivels after it is washed. But how are the springs designed and how are they hooked together? The X rays have answered. As a result cravats that will not wrinkle easily are on the market—one of the incidental rewards that we already reap in the effort to create life.

An important step toward the production of a true synthetic protein fiber and skin was announced

by Dr. Robert B. Woodward of Harvard in 1947. He described his achievement in a brief communication in the *Journal of the American Chemical Society*. The formulas there presented stand for a protein-like stuff, a clear, thick liquid about as viscous as mucilage. Woodward loads a hypodermic syringe with it, pushes the piston, and out comes a thread that looks and feels like silk. Or he pours some of it on a piece of glass and lets it harden rapidly into a membrane that can be peeled off like skin.

There are hundreds of sticky solutions of cellulose that will form threads and skins in the same way. If this new one is exciting it is because it comes so close to nature and because it consists of nitrogen, the stuff of which all protein is made, combined with carbon, oxygen, and hydrogen, and because it presents the possibility of making expensive fur cheaply in vats, not only furs indistinguishable from those of a fox or a mink but furs of a quality, type, and splendor that outdo nature. Imagine a coat or wrap of ermine, sable, or seal sold for twenty-five or fifty dollars, yet so "natural" that an expert would have to examine the attachment of the fibers to what looks like skin before he could determine its origin.

Just as hundreds of dyes not found in the juices of animals or plants are synthesized from derivatives of coal tar, so it will some day be possible to construct downs and wools of a lightness, fluffiness, and warmth not yet approached by any living creature, as well as leathers with properties which may be either like those of cowhide and pigskin or utterly different.

From the scientist's or even from the businessman's point of view it does not matter much whether or not these new fibers and hides would fool a silkworm or a cow. Nylon looks like silk but is in many respects superior, and no woman cares whether it is made by a worm or whether it is a synthesis of compounds that come from coal, air, and water. Rubber has not yet been synthesized, but the manufacturer accepts what is erroneously called "synthetic rubber" because for many purposes it surpasses natural rubber. So with these synthetic fibers of Woodward's. They certainly have a place in organic chemistry and probably in industry. More important still, they open a vast field for exploration.

Like some other organic chemists, Woodward started with amino acids. When we consume and digest a glass of milk or the white of an egg we break down protein into its constituent amino acids, whereupon we build the acids up again into scores of different forms, such as muscles, tendons, skin, nails, blood, and hair. It does no good to swallow amino acids to try to simplify the process of making flesh and hair. Nature insists that we go through the process of tearing down protein and putting it together again in new forms. We eat for no other purpose. Protein is life.

Until Woodward did his work no one had ever come so close to reproducing a constructive living chemical process in the test tube. Yet the underlying principle had been known for years. It is a principle called "polymerization," which means the construction of giant molecules (polymers) from small molecules (monomers). The amino acids are the small molecules or monomers, and the proteins are the giant molecules or polymers.

How are small molecules to be built up into giant molecules? The process has been highly developed in some branches of chemistry, with the result that we have so-called "synthetic rubber," plastics, paint, films, nylon and other fabrics. All these polymers are chains of smaller molecules but not of amino

WIDE WORLD STUDIO

WALDEMAR KAEMPFFERT, science editor of *The New York Times*, is a leader in one of our new professions. It has been said that "no one has done more to bridge the gap between the abstract hypotheses of the laboratory and the mind of the common man" than Mr. Kaempffert and he is often referred to as dean of science writers in the U. S.

A native New Yorker, he took his bachelor's degree in science at New York City College and his law degree at New York University. He served as assistant editor and managing editor of *The Scientific American*, editor of *Popular Science Monthly*, and as first director of Chicago's Museum of Science and Industry before joining *The New York Times* staff as science editor.

His writings have received great recognition and this year, UNESCO honored his distinguished career in science writing with the award of one of the world's highest scientific honors, the Kalinga prize of 1954. The prize was established in 1952 and provides for an annual grant of one thousand pounds sterling from the Kalinga Foundation Trust of Cuttack in the State of Orissa, India to give recognition to the new profession of science writing.

This article will suggest why his writings are so widely read and respected.

acids. Sometimes the chains are fairly straight, as in cotton, but usually they are kinked like wool, tangled and even snarled into masses like gelatin. Protein is also a chain, which may be fairly straight, as in silk and hair. But in the protein we eat, the chain is wound up into a ball, like yarn. In the process of digestion the chain is straightened out by the pepsin of the stomach and the overgrown chains are broken into smaller ones which are known as "peptones."

All this had been established by the late Dr. Emil Fischer, Nobel prizewinner. He spent a good part of his life trying to piece proteins together and achieved a partial success. He never approached a synthetic beefsteak, but he headed chemists in the right direction. Simple chains of amino-acid molecules he called "peptides," and the whole class "polypeptides." He was staggered by the many ways in which amino acids could be combined. Considering all the permutations and combinations, he estimated that the number of possible proteins must be 128 followed by twenty-five zeros. In this way he explained the infinite variety of plant and animal life and also the difference between horn and flesh, the protein in milk and the protein in blood. Some chemists hold that only certain combinations of amino acid molecules are possible and that the number of proteins is therefore limited. Woodward, however, like many others, holds with Fischer's conception.

With great difficulty Fischer managed to string eighteen amino-acid links or units into a chain. His pupil, Emil Abderhalden, made a similar peptide chain of nineteen links. Whether or not these were true syntheses of protein is still a matter of dispute. The reason is that a polymer of protein contains thousands of links, and not until the sequence of the links has been established can the chemist be sure that he has a protein—or has not. Woodward has made chains ten-thousand units long, and still he is not certain that they are true protein.

It is easy enough to grasp the reason for this uncertainty. Molecules of amino acids are hooked together like paper clips to make silk or any other form of protein. Suppose that you have a chain of clips which consists of copper, steel, brass, silver, gold,. and rubber links, and suppose the chain is a mile long. For 100 feet the sequence copper—steel—brass—silver—gold—rubber, holds good. Then a new sequence begins: rubber—gold—silver—steel—copper, and continues for 100 feet. Will the next or third sequence be the same as the first? It is impossible to predict. The whole chain must be examined until all regularly recurring sequences are noted. Long as a chain of ten thousand amino-acid units may be, compared with Fischer's, it is not long enough, and that is why Woodward will not call his synthetic fibers anything but "protein analogues."

It was while he was traveling to St. Louis in a train that Woodward thought of a way of making amino-acid molecules link themselves into chains and form a peptide. When he returned to his laboratory and looked up the literature he found that the same idea had occurred to two German chemists, Leuchs and Geiger, in 1908. They had started the process of polymerization with water and ended with a product that was insoluble in water, which is significant because complicated proteins cannot be dissolved in water. There was no technical reason why Leuchs and Geiger should not have made long chains of peptides over a generation ago and thus anticipated Woodward. The significance of starting with water a process which supposedly required an enzyme—that is, a living catalyst—was lost on them.

Dr. Woodward also uses water to start the orderly accumulation of monomers to form polymers of amino acids. He simply lets the solution stand. As the days pass it thickens. In two weeks at ordinary temperatures (sooner if heat is applied) the viscous mass is ready.

What is to be done with this new product? Romantic possibilities are presented. They do not end with synthetic silk, wool, fur. If the chains of peptides are connected crosswise all kinds of skins and leathers may be produced, many of them unlike anything found on animals.

After synthetic fibers will come the chemical equivalent of meat, milk, white of egg; for the difference between a hair and a slice of beef is largely a difference in architectural style of protein structure. What this means is enough to fire the imagination of any dramatist or novelist. It is not wildly improbable that when more is known about the way giant molecules can be built up from small ones in accordance with different architectural plans the nutritive equivalent of meat or milk will be synthesized. Not only this, but entirely new types of "meat" or "milk" may be created. These synthetic proteins will not assume the form of choice cuts of beef or milk that can be poured out of a bottle. They may be sticky fluids or shapeless lumps of matter like gelatin. But they will be edible.

This first synthetic edible protein will be so expensive that it will be utterly unimportant to the man who lunches at a snack bar. But eventually practical medicinal foods will be made to order. In

(Please continue on page 285)

Science Teachers Explore RESEARCH

By JOHN H. WOODBURN
Assistant Executive Secretary, National Science Teachers Association

Can experienced science teachers gain ideas for improving school laboratory work by interviewing successful government, university, and industrial research scientists?

TO ANSWER THIS QUESTION was the goal of the August 13-27 West Coast Science Teachers Summer Conference, a cooperative effort of the Crown Zellerbach Foundation, Oregon State College, the Future Scientists of America Foundation of NSTA, and thirty-two science teachers.

Interviews in the laboratories of research scientists were later "milked dry" of implications for school science laboratory activities. Such implications were then translated into recommendations. In turn, new laboratory exercises were prepared to put these recommendations into action.

This is one version of their report.

LATE this summer, thirty-two science teachers set out to see if their high school science laboratories are in tune with what young people need to make them successful in modern scientific research. The teachers returned with an amazing picture of what university, government and industrial research people are doing.

Three features marked the success of this conference. First, the participants produced detailed directions for twenty-seven new or modified laboratory exercises which, in their opinion, involve more of the skills they saw being used in research laboratories. Second, their visits with research people were very cordial. They were brought up-to-date on many new developments in science and gained new ideas on how science teaching can be improved. Third, and what may be the most valuable outcome of all, the teachers and their two co-directors, Professor Stanley Williamson and the author, gained experience in how to work together as a research team assigned to solve a specific educational problem. The Foundation is looking forward to further opportunities for similar research teams to tackle educational problems of interest to all science teachers.

Upon entering Professor A. D. Hughes' laboratory, the fragrance of peppermint oil identified his interest in applying modern engineering principles to improve the quality and yield of mint oil. One of his colleagues at Oregon State College, Dr. P. O. Ritcher, was busily raising grubs of the rain beetle, *Pleocoma minor Lindsay*. Only a few years ago, this beetle was but a rare collector's species. Now, Dr. Ritcher is especially interested in the life history of the rain beetle because it was found feeding on the roots of the apple trees in Oregon's famed Hood River Valley. He knows his only chance to wage effective control measures will come from finding a vulnerable stage in the life history of the pest, now found as frequently as two grubs per square foot in the infested areas.

It was Dr. John Milbrath who responded to Oregon's stone fruit growers' alarm over seeing their cherry, plum, and peach trees slowly becoming diseased, stunted, and malformed. Recognizing the symptoms of virus infection, Dr. Milbrath is bring-

ing not only his own research to bear on the problem but he is also encouraging his associates at Oregon State to aid in the development of chemical inhibitors, resistant strains, and healthy nursery stock. Three colleagues, B. E. Christensen, K. S. Pilcher, and James Carpenter are also studying virus. They are interested in mumps and influenza; they rear virus cultures in chick embryos in order to test the effects of new bio-chemical inhibitors. Using the new electron microscope, these men are adding much to our basic knowledge about viruses.

The interviewing team of 32 science teachers returned from Dr. L. A. Pettit's Food Technology laboratory with their mouths and pockets full of dried green beans. Working under an Army Quartermaster Corps contract, Dr. Pettit discovered that freezing green beans prior to dehydrating produced a product that scored high on taste panel tests. Security regulations required Dr. Edward Bubl to by-pass portions of his work on the preservation of food by ultraviolet, neutron, X-ray, and cathode radiation. However, he could tell the interviewing group about using radioactive wastes to make bacteria "biologically dead"; that is, unable to reproduce even though still alive.

Dr. E. F. Kurth in the Oregon Forests Products Laboratory became interested in how wood as a building structure withstood earthquake damage and is testing quarter and full scale wooden roof, floor, and wall panels. Chemical experiments prove that cork, bast fibers, tannin, waxes, and several other products can be obtained from Douglas fir bark.

The developing immunity of house flies to DDT is Dr. L. C. Terriere's interest. He has found that sex, temperature, stage of metamorphosis, synergism and other factors affect flies' ability to metabolize DDT. Using "tracer" isotopes, he has found

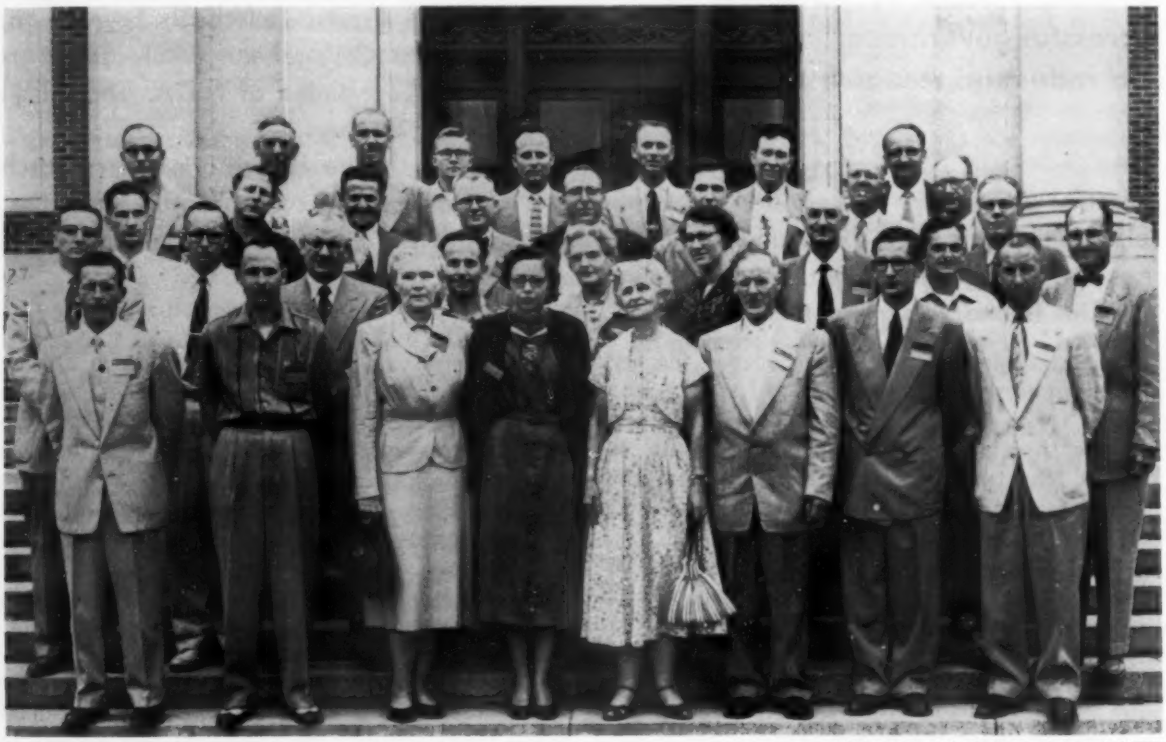

PHOTO BY OREGON STATE COLLEGE NEWS BUREAU

Participants in the 1954 Crown Zellerbach West Coast Science Teachers Summer Conference. FIRST ROW (left to right): RICHARD F. THAW, Corvallis H. S., Corvallis, Ore.; ROBERT K. HENRICH, Columbia H. S., Richland, Wash.; GLADYS B. HERRON, Klamath Union H. S., Klamath Falls, Ore.; VIRGINIA F. KENT, Edmond S. Meany Jr. H. S., Seattle, Wash.; ALPHA H. FIFER, Carson Elementary Sch., Carson City, Nev.; MOULTON G. CLARK, Kennewick H. S., Kennewick, Wash.; LOUIS B. ALCORTA, Abraham Lincoln Sr. H. S., San Francisco, Calif.; PAUL STONER, Mt. Diablo H. S., Concord, Calif. SECOND ROW (left to right): STANLEY E. WILLIAMSON, Oregon State Coll., Corvallis, Ore.; NEIL W. SHERMAN, Elementary Schools, Phoenix, Ariz.; WILLIAM H. HUDSON, J. A. O'Connell Technical Institute, San Francisco, Calif.; JOHN H. MAREAN, Reno H. S., Reno, Nev.; GRETCHEN B. GEORGE, Newberg Union H. S. Newberg, Ore.; GENEVIEVE M. SWICK, Eureka County H. S., Eureka, Nev.; FRANCIS D. CALHOON, Berkeley H. S., Berkeley, Calif.; MYRL R. BARKHURST, Myrtle Creek H. S., Myrtle Creek, Ore., HOWARD E. HICKCOX, Lebanon H. S., Lebanon, Ore.; JACK FISHLEDER, Wickenburg H. S., Wickenburg, Ariz. THIRD ROW (left to right): LEE R. ARMSTRONG, J. V. Weatherwax H. S., Aberdeen, Wash.; TED B. BOWEN, Ellensburg H. S., Ellensburg, Wash.; LESLIE J. WEIGART, Grants Pass H. S., Grants Pass, Ore.; EUGENE ROBERTS, Public Schools, San Francisco, Calif.; CLYDE F. POWELL, Santa Ana H. S., Santa Ana, Calif.; ROBERT S. STRONG, Grandview H. S., Grandview, Wash.; CHARLES O. BLODGETT, San Luis Obispo H. S. and Jr. Coll., San Luis Obispo, Calif.; CLARENCE W. STRONG, Springfield H. S., Springfield, Ore. FOURTH ROW (left to right): HOWARD I. MONKS, Marshfield H. S., Coos Bay, Ore.; MARTIN MORTENSEN, Ariz. State Coll., Tempe, Ariz.; ROBERT C. WHITNEY, Bellevue H. S., Bellevue, Wash.; GEORGE S. SCOTT, Grangeville H. S., Grangeville, Idaho; DWIGHT K. RUNNER, Raymond H. S., Raymond, Wash.; JAMES T. ROBINSON, El Rancho H. S., Rivera, Calif.; DON C. LILLYWHITE, Mesa H. S., Mesa, Ariz.; JOHN H. WOODBURN, NSTA, Washington, D. C.

that flies can transform DDT into a non-toxic compound "X" which appears in fly specks. Dr. Lamar F. Remmert in Oregon State's Department of Agriculture, intrigued by the killing power of insecticides and herbicides, is also trying to find out how they work. Guessing that certain vital enzyme actions are affected, he is tracing the basic photosynthesis and respiration processes to see at what stage the 2-4D becomes effective. Somewhat similar strategy is being used by Dr. C. H. Wang in exploring the "Color Added" story. He is using tracer isotopes and chromatography to follow the role of ethylene gas in the ripening of fruits. His strategy is also somewhat similar to that of Dr. Vernon H. Cheldelin, Director of the Science Research Institute. While his over-all problem is to determine how compounds taken into the body contribute to the life process, he and his staff are currently studying the energy-yielding breakdown of carbohydrates. Dr. Ernst Dornfeld's study of factors which cause or inhibit cell division is equally close to basic life processes and has added interest for cancer research. He has developed effective laboratory techniques using the paired ovaries of newborn rats. A promising approach to inhibition appears to lie in the nucleic acid synthesis of the cell.

Expensive litigation caused by cloud-seeding operations in the Northwest has prompted Dr. Fred C. Decker and John Day in Oregon State's Physics Department to design a way to see if the seeding really causes rains that wouldn't have fallen without abnormal efforts. An "umpire" is to flip a coin to determine whether or not seeding operations can proceed when the seeder decides that the cloud energy situation is ripe for seeding.

To show how geologists approach their problems, Dr. Ira S. Allison confronted one interviewing team with some large granitic boulders which seemed to be out of place in the nonglaciated Willamette Valley. He let the group see if their tentative guesses would stand the test of on-the-scene observations until a satisfactory explanation was established.

Dr. Leslie A. Clayton traced his Civil Engineering Department project to the fact that ordinary culverts on steep grades flowed less than half full even when operating at maximum discharge with deeply submerged entrances. Taking their cue from a culvert designed by a Portland Bureau of Public Roads engineer, and deriving new ideas by hydraulic formulae, they tested their ideas with plastic models until a 100% improvement had been reached.

Realizing that Oregon State's new cyclotron is being built from concrete blocks originally used as ship ballast, a 2300-volt D.C. motor-generator do-

PHOTO BY OREGON STATE COLLEGE NEWS BUREAU

A group of the conferees in the Oregon State College Food Technology Laboratory.

nated by the City of Eugene, Oregon, and iron magnet cores from the AEC, the visiting teachers found research scientists using some of the same methods they themselves use in developing student science projects.

Although Dr. Ronald Geballe's original interest in the dielectric properties of CF_3SF_5 was strictly "basic," when he found that each time a spark passed through the gas, its insulating quality *increased*, he and his colleagues in the University of Washington's Physics Department acquired additional interests.

At Reed College, Dr. Arthur F. Scott tries to match research projects with the skills and interests of the staff and students in his department of chemistry. One group is using tracer isotopes and chromatography to test the hypothesis that two separate enzymes hook the glutamic acid, glycine, and cystine system together in peptide bond synthesis. Under the auspices of the Heart Society of Oregon, Dr. M. W. Cronyn has isolated hyaluronic acid from the vitreous humor in quick-frozen beef eyeballs. This rare and costly substance may lead to an inhibitor for rheumatic fever and arthritis.

In the realm of state and federal government research laboratories, the teachers found a variety of projects. Dale E. Schoeneman and Charles O. Junge of the Washington State Department of Fisheries liberated salmon fingerlings at various points along power dams to see how many would be killed while falling freely, falling over the spillway, or falling down turbine penstocks. A colleague, G. A. Holland, has determined the concentrations of sulfite waste liquor from paper mills which young salmon can tolerate in water with adequate oxygen supply.

Several biologists at the University of Washington

School of Fisheries are looking for ways to guide young salmon away from the intake areas of turbines. They have devised clever equipment to test the effects of air bubbles, light, force of current, and electricity. The visiting teachers were especially intrigued by the fish ladder which has been used to see if fingerlings spawned and marked in the Fisheries School laboratory would return as adults to spawn in the laboratory. They did.

How to let commercial fishermen catch a maximum number of silver salmon and still allow adequate breeding stock to return to the spawning grounds is the problem of Kenneth Henry at the Oregon State Fish Commission. Quotas have to be based on the number of fingerlings produced three years ago since biologists lose touch with salmon during the three years required for them to reach maturity. Jergen Westerheim, a colleague of Mr. Henry, has proved to commercial fishermen that a one and one-half inch increase in the mesh size of their otter trawl nets will reduce from 64% to 10 to 15% the great numbers of non-marketable fish which were killed by the long haul at the bottom of the ocean.

Dr. M. E. Stansby and his associates at the Seattle branch of the U. S. Fish and Wildlife Service are completing the first full-size equipment for electrically guiding migrating fish. The interviewing team was intrigued by how successfully the laboratory model diverted salmon fingerlings toward or away from experimental barriers. In this same laboratory, Miss Karrick is leading research on the basic chemical composition of fish. She thinks they are on the trail of some new growth factors which may be undiscovered vitamins.

The visiting teachers met some new concepts of cleanliness at the U. S. Bureau of Mines Electrodevelopment Laboratory. Dr. Earl T. Hayes and E. D. Dillings reported how a washroom soap powder containing borax had left traces of boron on the hands of men who were working with zirconium. One of the uses of this rare metal involves its transparency to atomic radiations. Impurities such as boron, in excess of one-half part per million, are intolerable. Until the soap-powder problem was solved, operations at the Albany, Oregon plant had to be shut down.

In many respects, the teachers found that industrial research was not unlike what they saw in university and goverment laboratories. The four men who were given a full-day tour of the Crown Zellerbach tree farms were particularly impressed by the new thinning practices. During five years of management, a 10-acre tract of Douglas fir

produced a total cash profit of $4,062.60 from the sale of thinned trees. The trees remaining in the lot have a greater cash value than would have been received from the total harvest of unthinned trees, truly a case of "eating your cake and having it, too."

Quality control, new product development, by-product utilization, and waste disposal are the topics of interest to Dr. W. W. Moyer and his staff in the Crown Zellerbach Central Research Development Laboratories and Pilot Plant. Dr. W. M. Hearon told of their development of Orzan, a soil conditioner reclaimed from paper-mill wastes. With only 50% of the logs actually accounted for in finished products, waste utilization is quite a challenge. The isolation of conidendrin from waste liquor has been Dr. Hearon's project. Present in hemlock liquor in 1% concentration, if all the liquor of the Camas mill was treated it would produce 6000 pounds of conidendrin daily. Now he must find a market for conidendrin.

Methods of operation at Tecktronix Incorporated were illustrated for the interviewing team. When, under rigid inspection, a cathode-ray tube of their own design showed a "pip" instead of a straight line, everyone joined in the search for the cause and a solution. After many likely guesses had been checked and still the "pip" remained, one member of the group recognized that the shearing of the stainless steel deflector plates had slightly magnetized the rough edges causing the irregularity. Annealing the plates in a hydrogen flame solved the problem. Don Keppler, Personnel Manager, attributes the success of his company to the ingenuity and enthusiasm of the whole team. Assembly lines in the ordinary sense do not exist. Workers assemble whole units, some requiring a thousand operations. Only the beginners work from models, experienced operators rely on memory. Although electronic equipment requires infinite attention to detail, workers are transferred from unit to unit to escape boredom.

The plywood adhesive industry is so competitive that the Seattle branch of the American-Marietta Company is willing to search hard for even minor improvements. If the time in the heating presses could be reduced from nine to seven minutes, the output of a plywood mill could be increased nearly one-third. William Haigh is adding a statistician to his research group to handle the great number of variables which affect veneer adhesives. For example, sheets of veneer will differ according to the species of tree; if the same species, the geographical area in which the tree grew; if it grew on the ridge or in the valley; which side of the ridge it grew on; when it was cut; how it was peeled; and so forth.

In 1941, the members of the Western Pine Association gave their research laboratory this problem: Produce a sealer for knots in pine lumber that will be clear in color, fast drying leaving a flexible film, insoluble to resins in the knot and paint applied, a good base for paint, and withstand weathering for four to six years. None of 200 commercial products tested would meet these standards so knots were analyzed to see just what compounds leach out to discolor the paint. This analysis dictated the physical and chemical properties of the desired sealer. After 578 tries, WP-578 Knot Sealer, was compounded from polyvinyl butyral, phenolic, and alcohol. Mr. Sarvis, Wood Chemist, is now working on a pigmented sealer that will also serve as an undercoat.

After A. A. Soderquist, Administrative Engineer, had oriented the visiting teachers to the total role of the Process, Metallurgical, and Standards Units in the Boeing organization, two representative research projects were presented. During the early B-52 pre-flight tests, high temperatures and flutter from the jet blast blew off the plane's highly stressed wing flaps. Jim Barbee and his Adhesives Group have developed adhesive bondings which are going through final intensive trials. A second project involved the collection of moisture on the inside of the skin of high-altitude passenger planes. This moisture would soak up insulating materials thus adding dead weight. Mr. G. F. Hughes traced the rise and fall of several hypotheses which promised to solve this problem.

All of these interviews were conducted to help the teachers answer a specific question—Are high school science laboratories in tune with what young people need to make them successful in modern scientific research? What was their answer? Since the research scientists they visited are the product of the educational facilities which exist in America, the teachers realized that their recommendations and suggestions can only lead to improvement of existent facilities. The group did, however, come up with eighteen specific recommendations—recommendations which they believe represent practical ways for teachers to inject more of the "tactics and strategy of scientific researchers" into the laboratory phases of high school science teaching. These recommendations and twenty-seven laboratory exercises which expedite the recommendations will be sent to NSTA members by way of a special insert in the February 1955 issue of *The Science Teacher*.

Analysis of a Science Talent Search Examination

By FLETCHER G. WATSON

Associate Professor, Harvard Graduate School of Education, Cambridge, Massachusetts

EACH YEAR as part of the nationwide Westinghouse Science Talent Search conducted by Science Clubs of America, administered by Science Service, two to three thousand high school seniors take a difficult science aptitude examination. The nature of the competition and the quality of the pupils selected through it have brought nationwide attention to the examination. Yet, it appears that only one study of the examination (that of the Fourth Search)[1] has been published. This paper is a brief investigation of certain aspects of the Twelfth examination given in December, 1952.

As the annual examinations are not kept secure, new examinations are prepared each year. After the first year, however, the structure of the examination was stabilized with three parts. The first section (A), of 50 items, examines primarily the sorts of recall information that a pupil might obtain in science classes and from textbooks. The second section (B), also of 50 items, presents novel selections mainly from current scientific literature far removed from subject matter that the pupil is likely to have encountered. Each passage is followed by several items of increasing difficulty. The effort here is, apparently, to determine how the pupil can apply in novel circumstances the kinds of discrimination and selection which involve scientific principles and procedures. The third section (C), of 40 to 50 items, involves knowledge attained through outside reading, laboratory work, or some other aspects likely to be beyond a textbook reading knowledge. While the total number of items in the test varies slightly from year to year, it is generally between 140 and 150. According to Science Service, the scores of pupils taking the examination usually range from as low as 10 to 15 to as high as 110 to 120. National honors are awarded to boys and to girls in proportion to the number of each sex which filed completed papers.

Those who prepare the examination each year have indicated that they believe section B produces the greatest spread in the final scores. That is, this section contributes the greatest variance to the total scores. The following investigation was begun to test this hypothesis.

Through Science Service the complete papers for the 200 entrants from New England in the Twelfth Science Talent Search, 1952-53, were available for study. With the assistance of Mr. James Pitts and Mr. Lars Wiberg the following mean scores and standard deviations were derived.

Upon examining the table of scores, we note that the highest subscore total was for section B and that this section also had the highest standard deviation. Of the three sections it therefore, as suspected, contributes most heavily to the dispersion of the total scores; that is, section B is in terms of this examination the most discriminating.

A sex differential between boys and girls amounts to 12 points in favor of the boys. This is compounded of roughly 4 points on section A, 7 points on section B, and 1 point on section C. The chances that by accident we would draw from a homogeneous population two samples having these scores is far less than 1 in 100.[2] We therefore conclude that there is a real sex-differential among the students whose papers were considered here. Early realization of this sex differential[3] is the reason that in the Science Talent Search boys are compared with boys and girls with girls. Of the 6 in this sample receiving national honors, 5 were boys.

To examine the degree to which section B contributes to the final scatter of scores, the correlation coefficients, r, between scores on the sections and on the total test were derived, Table 2. In

[1] Edgerton, H. A., and Britt, S. H., *Educational and Psychological Measurement*, Vol. 7: 3; 1947.

[2] "t" exceeds 4.5.

[3] Edgerton, H. A. and Britt, S. H., *Science*, Vol. 100: 192; 1944.

TABLE 1

Group	No.	Means and Standard Deviations of Scores							
		Total		A		B		C	
All	200	60.45*±16.02		19.57±5.92		26.07±7.82		14.81±5.14	
Boys	148	64.65	16.54	20.98	6.36	28.39	8.12	15.28	5.07
Girls	52	52.54	15.05	16.85	4.68	21.10	7.22	14.60	5.33
By States: Connecticut (1 honor)	68	60.5	13.3	19.5	4.7	26.1	6.7	14.9	5.2
Maine	14	58.3	14.6	19.0	5.2	27.4	7.5	11.9	4.1
Massachusetts (3 honors)	76	64.4	16.8	21.2	6.2	27.6	7.8	15.5	5.4
New Hampshire (2 honors)	29	52.5	19.3	16.5	7.1	22.0	9.8	14.0	5.2
Rhode Island	12	57.9	8.9	18.8	5.1	24.6	4.8	14.6	2.4
Vermont	1	54.	—	17.	—	21.	—	16.	—
Receiving honors	6	94.7	14.4	31.7	7.1	37.8	6.7	25.2	2.8

* Range: 27 to 113.

the following tables T stands for the total test while A, B, and C stand for the sections.

TABLE 2

Correlations between scores on total test, T, and sections A, B, and C.

	All entrants (200)	*Girls (52)*
r between T and A	0.890	0.878
T and B	0.898	0.904
T and C	0.768	0.821

All the correlations are significant and are surprisingly high. Scores for girls have the same internal correlations with the total as do scores for the whole group of which girls comprise only one fourth.

With these correlations between scores on the three sections and the total, the relative weights of the sections in contributing to the total dispersion can be found. For a section, denoted by *i*, the weight is given by $W_i = \frac{\varsigma_i}{\varsigma_T} \times r_{Ti}$. The weights for this sample of examinations are $W_A = .33$, $W_B = .44$, $W_C = .23$.

To explore further the interrelations between the sections, correlation coefficients between the sections were derived for the total sample.

TABLE 3

Correlations between sections A, B, and C

r between sections	A and B	0.698
	A and C	0.551
	B and C	0.466

Again all the coefficients are statistically significant and near the values found for a comparable sample of papers from the Fourth Examination.[1] Sections A and B are highly correlated; that is, a pupil scoring high on one of these sections is quite likely to score high on the other section.

Finally the partial correlations between the sections were derived. These are presented in the form AB.C which is read "the partial correlation between sections A and B when section C is held constant."

TABLE 4

Partial correlations between sections A, B, and C

r for AB.C	0.597	significant[4]
AC.B	0.357	significant
BC.A	0.136	not significant

Even when the influence of section C, which contributes somewhat to the dispersion in total scores, is held constant, sections A and B are strongly correlated. The interrelation of sections A and C is significant, but not impressive. However, after allowance is made for section A, the scores on sections B and C are not significantly related.

In less statistical terms, we may assert that the scores on sections A and B identify much the same pupils. This does not justify the conclusion that these two sections are necessarily appraising the same characteristics in the pupils, but only that if they have one set of attributes (A), they are likely to have the other (B). By contrast, after allowance is made for the behaviors required by section A, the abilities required in section B are NOT duplicated in section C.

General Comment: While the 200 papers studied here represent less than ten per cent of the total entrants in 1952-53, the high significance of the relationships found suggests that they would also be found in a study of the total set of papers for this test. Certainly more extensive study of the Science Talent Search Examination is to be desired, for this test has attracted nationwide attention and significance.

In conclusion, two personal observations may stimulate further discussion among teachers. To encourage pupils who will score as low as 10 or 15 on the examination to struggle with it and to prepare the other materials required in the Science Talent Search, seems almost cruel. On the other hand, each year more individuals receive Ph.D.'s in science after collegiate and graduate study than there are high school seniors entering this competition. It is then clear that high school teachers are encouraging only a small fraction of their most competent pupils to enter this competition.

[4] For the test of significance see Lindquist, E. F., *Statistical Analysis in Educational Research,* Houghton Mifflin, 1940, p. 212.

The Fourteenth Annual Science Talent Search to find 40 promising science-minded high school seniors is now underway. Closing date for this year's search is December 27. For complete details of the National and State Science Talent Searches write to Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

A STUDENT REPORT

EXPLORING AND DEVELOPING A SCIENCE INTEREST

By CHARLES YULISH

Senior Student, Miami Beach, Florida, Senior High School

I HAVE been asked to give a sort of capsule report on how and why I have become interested in the field of atomic energy. First, here is a brief resumé of the factors which controlled me until a little over three years ago. Until 1951 I had been a highly mischievous boy, to say the least. My marks in school were mediocre and I was always a major contributor to any pranks or plots which developed in school or out. My educational diet consisted of low-calorie comic books and the usual twenty-five-cent thrillers.

For some reason, which is still beyond me, I became dissatisfied with myself almost as much as my parents were. I began to look for something which would both occupy my mind and satisfy my ego. I had noticed in some of the comics a trend to the "destroy the world with an atomic bomb" type of writing. I became aware of the fact that about the only news of atomic energy was that of the bomb. It sort of irritated me and I knew that something more should be done about it. I wrote a letter to the Atomic Energy Commission in Washington and asked them for some information on atomic energy and its constructive uses. Within two weeks I received a folder containing several booklets and reprints on radioisotopes and their applications in the fields of medicine, agriculture, and industry. This served to whet my appetite sufficiently enough for me to go down to the library and check out a few books on the subject. I slowly began to understand the terminology used in the booklets, and my interest jumped. I wrote back to the AEC and asked for further information on the subject. They seemed happy to comply, and shortly I received another folder full of information. I began to check out more and more books on atomic energy and slowly I began to realize the vastness of this program in America.

In 1952 I started biology in Miami Beach Senior High School. This was my first real contact with science as a beneficial asset to mankind. While groping my way around the world of the paramecium and bryophites, I began to wonder whether I could do any work in combining biology and atomic energy. When we began the study of plants the time came for me to make my decision. I remember one day my teacher, Miss Birdie McAllister, was talking to us about plant nutrition and metabolism. She said that a plant's diet consisted mainly of minerals such as phosphorus, manganese, and calcium. Then I raised a question. I asked her *how she knew* that the plant used all of these minerals. She referred me to the book but I still was not satisfied. Almost immediately she asked me to come to see her after school. I thought to myself, "I did it again, more trouble!" That afternoon I saw her. To my surprise I found her smiling at me and ready to offer me several books on the subject of plant nutrition. She sat and talked with me and wanted to know more about my work.

I soon found myself telling her about my interest in atomic energy and then I remembered about something I read in one of the books sent me by the AEC. I searched through my books and finally found the article I wanted. It was concerned with the use of radioactive phosphate as a fertilizer additive to study plant nutrition. I digested the text of the article and wrote a letter to the AEC in Oak Ridge asking them about the possibility of my using a small quantity of radiophosphorus so I could experiment with the isotope in relation to plant nutrition. About two weeks later I received a letter from Dr. Bryden of the Isotopes Division. He explained about the use of P-32 (the isotope of phosphorus) in plant nutrition and as a tracer and gave me some information on its handling, along with some booklets which told of the experiments being done with P-32.

About that time summer vacation time came along and I went up to Cleveland to work with my father in his store. While there I decided to stop in at the Victoreen Instrument Company and speak to the sales manager. He turned out to be Mr. Ben McIntire, a young and patient man. I told him of

my proposed experiments scheduled for the month of September. I told him how I had been using a Geiger counter which was designed only as a toy, and pointed out that if I was to do these experiments properly I would need a good Geiger counter, one like the "THYAC" which Victoreen manufactures for the government. I asked whether the company would loan me one for the duration of my experiments. You might say that I had nerve to make such a request, and you may be right—but I got the instrument on a forty-five day loan. Almost a year later, I still have the counter and Victoreen has repaired it twice at no charge.

Through Miss McAllister's interest I gained use of her anteroom. (This is adjacent to the biology laboratory in Miami Beach Senior High School.) I began to correspond with many companies asking them for donations of various instruments and materials, and I was successful to the degree of almost equipping a little laboratory. Over twenty companies have been of immense help to me in getting started. By the time school was in session for a month, I had already used one shipment of radiophosphorus and had an application in for larger amounts. There are certain amounts of radioisotopes which may be used without the consent of the AEC. In the case of P-32, one may order 10 microcuries and do with it what he pleases. But if you intend to use anymore than 10 microcuries you must submit a rather lengthy application to the AEC telling why you want the isotope, what you will do with it, what your safety devices consist of, what kind of instruments you have available, what experience you have, and the general procedure you will use in dispensing with the isotope. After you have submitted the form to the Isotope Division in Oak Ridge, you wait until it is reviewed. If it is approved, you will receive a form called AEC-374; that is the authorization for you to purchase the isotope from a supplier such as Abbott Laboratories or Carbide and Carbon Chemical Company, both located in Oak Ridge.

Slowly but surely we made progress. I had been feeding plant leaflets small amounts of P-32 and watching for any changes in structure or growth. By using a process similar to that of making X ray pictures, I was able to illustrate concentration of phosphorus in any part of the leaf by a slight glance at a picture. That is real evidence which is better than print in a book!

Now we were expanding; the lab called for more attention and additions. I had to set up concrete shields to cope with the amounts of activity we would be using. I was given a large amount of concrete block and brick by a local contractor. Then I had to carry them up three flights of stairs to the laboratory. Once the shielding and other additions were made things went smoother. I received an authorization from the AEC to use 500 microcuries of P-32, 100 microcuries of S-35, and 10 microcuries of Ca-45 (only 1 microcurie is allowed of this isotope without an authorization) for further research work.

I had an opportunity to give several demonstrations to interested students after school, and the response was good.

Our principal, Mr. Katz, got word about what was going on and decided it was time for him to take a look. I polished up the lab, went down to see Mr. Katz, and invited him up. We talked for almost an hour about the possibilities in our school. He looked over my letters from the AEC and various companies and was taken back by the scope of our program. From that time on I have had no better ally. He went to bat for me with the school board and got them to put in shelves in the lab. However, there was and is the problem of an instrument for use in the demonstrations we give and for use in the physics and chemistry classes. A demonstration type Geiger counter costs about $150 and we have not been able to talk the school board

PHOTO BY J. STREICHER

Mr. Charles Yulish at work in RELPAR (Radioisotopes Experimental Laboratory for Plant and Animal Research), Miami Beach, Florida, High School.

into buying us one, in spite of the honor of being one of the first (if not the first) high school in the United States to be authorized to use large quantities of radioisotopes for research and demonstration work. I have been unable to procure one of the instruments.[1] I have put an estimated $250 of my own money into the laboratory for materials I could not get donated, but I do not regret spending one cent of it.

Now I would like to tell you about the proposed plans of study my laboratory will offer this fall. A copy of this was presented to the AEC and was approved. An Atomic Energy Club will be formed, to consist of approximately 25 selected students. I will try to teach them the fundamentals of atomic energy and its applications in the various sciences. A special group of students will begin training after school on radioisotopes, techniques and applications. That will mean that after I leave the school, the lab will continue to function and will not be dependent on me for its existence. Its name is RELPAR, an abbreviation for Radioisotopes Experimental Laboratory for Plant and Animal Research.

We will offer to show movies to interested persons and groups on atomic energy and its peacetime applications in science and medicine. We will give demonstrations in the assembly to acquaint the student body and the teachers with certain fundamentals of radiation and radioisotopes. We will supplement the biology, physics, and chemistry classes of our school with live demonstrations on related phases of nuclear studies. This is not just what we hope to do, the plans have already been drawn and approved.

Another incentive to my work was the Science Achievement Awards offered by the American Society for Metals in the program conducted by the Future Scientists of America. I have indeed been fortunate to win awards in this contest two years in a row. I must admit I thought my chances were mighty slim but my first win gave me that push I needed. I saw that some people do have an interest in the work of high school students and see the possibilities of scientific research on a high-school level.

The Atomic Energy Commission honored me by inviting me to visit Oak Ridge during the time that Miss McAllister was there for the Institute for Nuclear Studies course on radioisotopes in secondary schools We were there June 7 through June 18. In those two weeks I learned more than through all my reading in two years. I saw the reactor and how radioisotopes are made, processed, and shipped. I visited Abbott Laboratories and found that Mr. Gleason, the manager, had been following our work with great interest.

The thing that has amazed me the most throughout my work is that the biggest men are the most interested. The AEC, the various companies, and the professional scientists are willing to do their part. But in essence, it is up to the teachers to awaken the students and themselves to the opportunities and the necessity of meeting this challenge head on.

With more "Miss McAllisters" to awaken the teen-agers' interests, and more "Dr. Brydens" to nurse them along, there won't be any trouble getting scientists for the future. With more programs such as the Future Scientists of America to give students the push and incentive that they need, an intelligent and resourceful generation will be ready to "take over" when our turn to assume responsibility arrives. This applies to all fields, and cannot be restricted to science alone. This is the story of one incident and one example. I hope it may help others.

[1] Since this was written, Mr. Yulish was given a $100 donation from the American Society for Metals, sponsor of the Program of Science Achievement Awards for Students mentioned later in his article.

Reading in Science as a Means of Improving the Junior High School Program

By CLYDE M. BROWN

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THE objectives of elementary school experiences, says Glenn O. Blough in his book, *Elementary Science and How to Teach It,* have been stated by all kinds of educators in all kinds of ways but that the most important purpose might be phrased: "to help children gain the ideals, understandings, and skills essential to becoming good citizens." What Dr. Blough has said for the elementary school holds true also for other levels of education.

We say that the study of science should help boys and girls develop command of scientific generalizations or principles which they can use in solving the problems of their environment. Also, we feel that the study of science should help pupils grow in their ability to solve their own problems more effectively. Too frequently, in trying to help children learn to solve problems, we adults hand down our adult conceptions of the problems of youth for treatment, rather than utilize the experiences of the boys and girls. As teachers we should enlist the aid of our students in finding the problems to be treated and then help them to get the information needed to arrive at better understanding. This should be a "doing" rather than a "telling" activity.

The science program provides children with countless problems that are of real concern because they are near at hand problems that possess a fascination because they are so intimately associated with young lives. The experiences which junior-high-aged boys and girls have today come to them in many ways and are world-wide in scope. Avenues for direct and vicarious experiences have widened immensely since the war. Consequently the formalized junior high science programs built around static subject matter outlines are so confining that it is difficult to keep the interest of students and really meet their needs.

Science teachers feel that their students' understanding of our changing environment demands a comprehension of some basic principles and laws of science. But unless these laws and principles are set in modern dress, teachers will have difficulty in getting them across to students. As teachers, we are aware of the areas in which the science needs in general education lie. If we establish such concepts as "The Earth's Surface is Constantly Changing" and "Man Has Put the Forces Of Nature To Work" as areas around which our students' activities shall be centered, then their interests can be utilized in directing the way in which the basic ideas may best be presented.

Teachers complain that the students do not read; i.e., they do not read the text assignments and they depend more and more upon the class presentations for their understanding of the basic fundamentals. Competition from radio, moving pictures, and, in particular, TV programs is cited as a reason for poor response to preparation of assigned textbook reading. Checks upon out-of-school activities have repeatedly shown that children in areas served by TV spend more hours per week watching programs than they spend in school and in preparation of school assignments.

Checks made in science classes in the University School at Southern Illinois University show, however, that boys and girls do read quite a bit. One class of fourteen students listed forty-four magazines from which they read more or less regularly. The boys read from twenty-four magazines and the girls from twenty-one, with several being used in common. While a number of these magazines might not receive the stamp of approval of science teachers as reputable sources of science information, they are those which carry the burden of presenting the scientific materials—good, bad, or indifferent—which are presented for public consumption.

In their reading statements the junior high students frankly admitted the reading of comic books. To the boys those presenting scientific and pseudo-scientific ideas of space travel and explorations have a great appeal. Science fiction stories have a large following and are avidly read by their fans of both the junior and senior high school levels. Our young readers are impressionable and to a certain degree gullible consumers of materials presented to them. We as science teachers need to assist them in distinguishing truths, half-truths, part-truths, and no-truths that they come upon in their reading.

Utilizing the motivating influence of the radio,

TV, motion pictures, comic books, and science fiction offers a challenge to the science teacher. Since a function of education is "to help boys and girls do better the desirable things they will do anyway," we must learn to utilize these programs and these readings to enrich our classes and to create a demand on the part of the students for reliable information to use as a measuring stick for evaluating what they hear, see, or read.

Several methods which seem to have possibilities for utilizing those ideas seen, heard, or read for the enrichment of the junior high science program may be suggested:

1. Clearing House Program

Devote class time at regular intervals to free discussions of questions which the pupils have. This is not necessarily just a period in which the teacher will hand out answers, but it will provide an insight into the kind of data the children are seeking. The teacher need not fear to say, "I do not know," in such a program but should be able to "help" them as groups or individually to find satisfactory answers. The breadth of his students' interests will amaze one who has not yet tried this technique of enriching his program.

Should the open question period just suggested prove too broad and unwieldly, a modification might be tried in which a student committee would call for written questions and choose those questions which seem to be of most universal interest for use in the class discussion period. The questions of more limited appeal can be dealt with individually.

2. How and Why Club

Boys and girls are naturally curious individuals, and science can provide them with the opportunities to find out the "How's" and "Why's" of their environment. They can be encouraged to read in their quest for *answers to their questions* rather than to read for just *facts*. They should be encouraged to question data presented to them and to determine the authority by which an author arrives at the assumption he propounds. In science classes we can help by providing reliable, authoritative sources for our students in a classroom library, the central school library, or a reference shelf.

3. Science in the News Program

As an incentive to spur reading of science materials in the current publications, a regularly scheduled session in which the pupils report upon science articles read from newspapers and magazines is

suggested. Discussions can lead to more discerning and observant readers and broaden the general information available to the whole group. Details as to frequency of session, length of reports, and desirability of follow-up research can be worked out with the groups. By stressing search for materials related to the general area being dealt with in the more formal part of the class work, more than incidental learning can be achieved.

4. Written Reading Reports

An organized free reading program can be coordinated with the "Science in the News" program by having the students make brief written reports of their readings. More than just a synopsis of the information in the article is desirable. The pupil comments concerning the articles may prove the most pertinent value, as the comments encourage thinking about what is read.

5. Science Seminars

Science reading interests will tend to group the students. These interest groups can organize seminars for more intensive study and discussion. Time can be arranged for the meetings during study or club periods, or after school. Facilities and guidance for experimenting should be provided if the groups' activities indicate a desire and need. Guidance for individual interests can be provided in such a program in special cases. Care should be exercised to see that the activities are pupil motivated and purposeful, with the teacher functioning as a guide and a counselor.

6. The Experimenters

Utilize pupil planned demonstrations and group experimentation to enliven the text and reference readings concerning science problems. The textbook provides common information for all that may be expanded by parallel reference readings by the better and/or more inquisitive students. Problems will be presented, and pertinent facts may need a supporting demonstration. The students in their discussions can determine where verification by experimenting is needed and may plan the activity.

7. Recreational Reading from Library Sources

Children who select and read books for pleasure seldom realize that science teachers classify some that they read as science books and others as nonscience books. To encourage a selection of good science-interest books there is a need for collaboration with the school or public librarian to establish a science shelf. We can develop the concept that there is a difference in reading for information and reading for recreation. Our pupils should also be encouraged to browse through the books on our science shelves before making their selections. Closed stacks in the library discourage many readers from making a varied selection and can retard wide usage of books in general.

Children like to talk about what they have read. Organization of a group of reading critics will help sell the reading of books to other students. By clipping brief written commentaries by the students into the library books which they have read concerning *their* opinions of the books and *their* recommendation of them to the other readers, an increased circulation may be encouraged.

In improving the program of science in the junior high school through a program of reading in science, we as science teachers need to help our students do better the desirable reading they are doing anyhow and to use the materials read as a motivating factor in our classrooms. Our students are already reading; they can be encouraged: (1) to read more widely varied materials; (2) to make a better selection of what they read; (3) to read more critically; (4) to make practical applications of the new ideas gained; (5) to share their reading experiences with others; and (6) to test their newly gained knowledge against authorities and by experimentation.

KAEMPFFERT—continued from page 268

the process of digestion, as has been pointed out, balls of yarnlike proteins are unrolled and broken down into their constituent amino acids. Suppose a sick stomach cannot unwind the balls. When that happens the doctor has to prescribe paps, porridges, and similar preparations. Some day the synthetic chemist will give the dyspeptic a ball of protein that even his sick stomach can unwind. A new era in the treatment of gastric disorders will begin. Breakfasts and dinners will be scientifically designed.

The sea is so full of fish, the barnyards so full of fowl, the ranges so full of cattle, that we are not likely ever to dispense with natural protein food. But it is possible that special proteins will be synthesized which may compete with so high-priced a food as caviar.

More important is the production of protein masses that will be the equivalent of muscle, which is composed of long fibers. It has been shown that when a muscle relaxes its state is that of shrunken wool. The chief difference between strands of hair and wool and strands of muscle fiber lies in the way in which relaxation is brought about. You can relax your arms or your legs but not the hair on your head. After stretching, hair and wool relax automatically when they are released, just like coiled springs. Dr. Dorothy Wrinch of Smith College who has devoted years to the study of the protein molecule, holds that something like a synthetic muscle or mass of tissue will some day be constructed, which will not be alive but which can be stretched and which will spring back when it is released. Shock it electrically and it will shrivel to half its size. Poke it, and it will twitch. Though Dr. Wrinch does not say so, it is possible that a structure of protein will be made which will throb like a heart but which can hardly be called alive.

With each discovery a new vista greets the imagination. Though Dr. Woodward is not given to romantic speculation and spins no Jules Verne tales of the future, he suggests that viruses and bacteria, both of which are proteins, can be modified in structure. Some modifications would rob the virus or microbe of its deadly properties, others would heighten them. In other words, it may be possible to change a virus like that of poliomyelitis or influenza or smallpox into a harmless peptide within the body, which means that we shall have an entirely new kind of vaccination.

When a serum or an antibiotic like penicillin is injected in combating disease the change for the better that occurs is chemical. This being so, why not dispense with sera, obtained from the blood of animals, or with penicillin, which must be extracted from a mold grown tediously and expensively in the factory? Dr. Woodward has gone almost as far as this. He has created antibiotics of the gramicidin type, which include gramicidin S (the "S" standing for Soviet Russia, where it was discovered), tyrothricin, bacitracin, and tyrocidin. All are short chains of amino-acid molecules, and all are so poisonous that they can be used only externally. Suppose more links were added to the chains, thousands of links. The properties of the resultant peptides would be totally different. Dr. Woodward has made such chains, but whether or not they are of medical use only a biological test can show. But no matter what may be the outcome of the biological tests the day is not very far off when our vaccines, antibiotics, and sera will be of purely historical interest; for all are variations of peptide chains or proteins, so that what is discovered about one is bound to clear up mysteries that still shroud others.

If the past history of synthetic chemistry is any guide we shall pass rapidly from the purely medical into the commercial stage of protein production. Advertisements will proclaim the virtues of Jones Protox ("No bone, no sinews, no waste—100 per cent muscle-building meat"), which will be made in vats as huge as a brewery's at a cost so low that the chemical equivalent of a chicken will be sold for 20 cents a pound. If you doubt it, look back and see how much the scientists and engineers have done with clothing and shelter and how little with foods. The trend is clearly away from the natural to the artificial, the synthetic. From skins to rayon, from damp, cold, gloomy caves to luxurious, electrically illuminated skyscraper hotels, from open fires to air conditioning—we have traveled far in 20,000 years. But food? We still kill animals and roast them over a fire, just as Peking Man did 500,000 years ago—the earliest man, a half-ape at that, of whom we have many relics. The achievement of something which is the chemical equivalent of muscle (meat) will mean much in the effort to create life in the laboratory.

The simplest form of life is the cell. Why not pick this apart? It has been done. And how does the analysis read? Nitrogen (the stuff of which protein is largely made), oxygen, carbon, hydrogen, a little chlorine, phosphorus, sulphur, sodium, calcium, silicon, iron, manganese, iodine, magnesium, and fluorine. Mix these together in the right proportions. You have—what? A laboratory mudpie. Something utterly meaningless. Life cannot be compounded like a doctor's prescription.

Of late years it has dawned on scientists that nature did not make life of a sudden and then

forget about it. They think now that life is being created around us every second but that we are not yet aware of the process. No sharp line divides the nonliving from the living. There is a no man's land which must be explored, a land where compounds are actually half alive, or a quarter or a third. So another approach to the problem of synthesizing life is to find out what this half-alive or one-third-alive stuff is, what forms it assumes, and how it can be jolted into full life.

Here we meet Dr. Wendell M. Stanley, Columbus of no man's land. His work leaves no doubt that some forms of matter that lie between the nonliving and the living are the viruses. Yes, the viruses that cause some diseases.

A germ is something manifestly alive, something which can be seen, though a microscope may be necessary. But so minute are the viruses in structure that they can pass through porcelain filters that hold back ordinary microscopic bacteria. Inoculate a man or a higher animal with the liquid that trickles through the filter and the disease characteristic of the virus develops—small pox, poliomyelitis, measles, rabies, mumps, parrot fever, warts, influenza, the common cold, some types of cancer—about thirty diseases in all.

It will be a tremendous step when the first virus is synthesized and inoculated to lay experimental animals low with one of the virus diseases. And medicine will know how to deal with such diseases more effectively than it does now. As it is, so widespread a virus disease as influenza is no more understood than is cancer.

The first of the viruses to be recognized as such was that which causes the mosaic disease of the tobacco plant. It is the easiest to collect in large amounts. For that reason it was selected for study by Dr. Stanley. Out of wagonloads of wizened, sickly tobacco leaves he squeezed juice. He added a little pepsin and saw that the virus was digested, just as meat is digested in the stomach. But pepsin, as everybody knows, is contained in the digestive juice of the stomach. It is what the chemist calls an enzyme, a ferment that breaks down the protein in food. This fatal virus, then, must be a protein. And protein, as we have seen, is necessary if there is to be life. He poured in a compound of ammonium to throw the virus or protein to the bottom of the tube, dried the sediment, and got—what? Crystals!

Now comes one of those dramatic moments in the progress of science that makes a laboratory worker feel like a god. Stanley inoculated a healthy tobacco plant with a little virus crystal. Touched by life the crystal sprang into life itself. It multiplied like a germ. Like a slow fire the mosaic disease spread, blighting leaf after leaf.

To grasp the significance of what Stanley had done, imagine that by the mere touch of your living finger a needle were to be endowed with life. Not only this, but that, once touched, it proceeded to pierce your hand and that new needles grew to pierce until at last you were a mass of wounds. Imagine that whenever you shook hands with a friend needles would also sprout in him and that he could pass on his affliction. A phenomenon like that would make men run away from needles or shield themselves from them.

Why are needles selected to drive home the significance of Stanley's discovery? Because needles are composed of crystals. No one ever saw a living crystal. Life does not assume crystalline forms. Look about you at plants, cats, chickens, men and women. There is nothing about them to suggest quartz, rock salt, marble. Do you see now why Stanley's discovery is of such awesome importance? A crystal, a lifeless crystal, flames into life at the mere touch of life!

Clearly the bits of the jigsaw puzzle are beginning to click together even in our time. Here are industrial chemists trying to give up protein threads, with the certainty that they will synthesize protein foods. And here is Stanley discovering that a virus is a protein, penetrating into no man's land and bringing back crystals that are as lifeless as a doornail but that leap into life when they touch life. There are others who are devoting their lives to the enzymes already mentioned, the ferments that make it possible for the chemical reaction we call "living" to occur at all. And still others look at a cell, an amoeba, any living thing, as if it were just an animated dynamo and confine themselves only to the electric forces at play. They are all adding to our knowledge of protein and indicating to some imaginary professor where their discoveries fit into the big picture of life.

Even if the chemists ultimately make proteins to order, the secret of life will not yet be in their grasp. Life is more than a matter of chemistry, an arrangement of nitrogen, hydrogen, carbon, oxygen, and some minerals. Forces must be harnessed. For example, there is the force that enables some insects to walk on a pond, makes a raindrop assume the shape of a sphere, causes water to roll off a duck's back. "Surface tension," it is called. It explains the movements of some micro-organisms and their shapes. Then there are pressures that enable nourishment to pass from a pond or a culture broth into the cell. Electric forces, too, must be considered; for there is good reason to believe that every living

cell has something in common with the electric battery which, when you press a button at the front door, causes a bell to ring in the kitchen.

Because of these complexities the explorers of no man's land and the creators of life will long have to trust to the kind of inspired floundering that gave us such inventions as the telescope, the steam engine, the telephone, and the automobile, and that led to such discoveries as X rays, radioactivity, and the relation of germs to disease. But whatever the method that may be adopted, the synthesist will not be mad enough to try and make a hen, with all its feathers and its ability to lay eggs and cackle. It took nature some hundreds of millions of years to reach the hen. Think of the billion cells in the brain and nervous system of a hen, think of the delicate intricacy of her eyes and their connections with the brain, think of the mechanism involved merely in scratching. Science will never be able to match such intricacy, such perfection. But science may achieve the synthesis of a simple living cell. This will be the greatest achievement ever recorded in the history of science—greater even than the release of energy from matter or the building of a space station to revolve around the earth like a little moon, or even than a successful voyage through millions of miles to Mars or Venus.

Some morning in the next century—it may be as early as 2040, though I doubt it—one of your descendants will let the web of paper that creeps out of the radio teletype in the living room slip through his hands and glance at the pictures and read the news headlines.

ROCKET SHIP GODDARD RETURNS AFTER SURVEYING CRATER PLATO ON MOON

"Nothing exciting about that," he will think, recalling the photographic maps of the moon that have been made by astronauts for 10 years and more.

GOVERNMENT MUST PAY MORE TO HAUL AWAY WASTE GOLD FROM NATIONAL ATOMIC POWER PLANT

"They had their troubles with ashes and clinker back in the twentieth century," your descendant comments to himself: "But this by-product gold is a nuisance. Can't fill in marshes with it as they used to with cinders. Every roof in town is of gold now."

And then your descendant stops. Can this next headline be true? He reads it again.

PROFESSOR H. Z. HASKELL CREATES LIVING MATTER. SEES FIRST ARTI-

FICIAL CELL MULTIPLY AND FEED. ALL TESTS FOR LIFE FULLY MET.

Assume that Professor Haskell has his simple cell. Why can't he and his disciples go further? Because evolution enters. The cell is just a difficult first step—one that nature herself took many hundred million years ago, one that must always be taken before even a bit of moss or a coral can be achieved. There are no short cuts to whales and men. When he makes his cell, or rather when he lets it make itself out of a broth of the right chemical composition, with the proper stimulants and forces at play, Professor Haskell will merely be mimicking nature. There is nothing for it but to let the cell evolve and see what happens. Are the scientists willing to wait a million years or so for the crudest plant or lowliest animal to appear? And then hundreds of millions of years more for a cod? The whole human race might be extinguished in the waiting and watching.

Luckily there are ways of speeding up evolution even now. New species of flowers and vegetables have been produced with the chemical colchicine, an old remedy for gout. We have seen that when X rays are turned on the eggs of the little flies that buzz around fruit, monstrosities have been hatched —flies which find their counterparts in two-headed, legless, and other monstrosities sometimes born on farms. Biologists call these sudden transitions, "mutants." Evolution is a gradual process of mutation—a permanent, hereditary departure from type.

Not much is known as yet about experimental evolution. But it is enough that with chemicals, X rays, and other agencies, mutation can be speeded up, so that even now we might be able to force Professor Haskell's cell to evolve. By the time that cell is created—remember, we are in the twenty-first century—evolution will be under control, so that biologists will be able to direct it. Even then progress will be slow. If the departures from type, the mutants, are too monstrous they die or are killed. When, for example, the teeth of mice begin to grow back into the jaw instead of out, a mutation that suddenly appeared spontaneously in an English strain, the chance of survival without aid is poor. The steps that lead up from the first bit of living protoplasm through the crudest creatures up to man are small ones.

You can see, even with this limitation, the lure of tampering with Professor Haskell's cell, of putting it through its evolutionary paces under control. Biology will become an exact science, like chemistry or engineering! Just as chemists make kinds of rubber for which nature had no use, so forms of life will be deliberately evolved that never had a chance in the jungle or the sea. "Survival of the fittest," the old phrase, will acquire a new meaning. It will be the white-coated man in the laboratory who will decide what is fit to survive and not the appetites and the teeth and claws of predatory animals. He will create an artificial world in which life will evolve in directions that were senseless to nature. The possibilities are already apparent in the one-eyed fish and the six-legged chicks that have been experimentally produced even in the present crude state of experimental biology and that have no survival value. "Missing links" in the evolutionary chain that give rise to so much speculation—there is no reason why they should not be made almost to order. The conditions that presumably prevail on cloud-veiled Venus or on arid Mars will be reproduced, and science will at last be able to decide whether or not life is possible under such conditions and how it evolved if it is possible.

Don't ask Professor Haskell's successors to toy with evolution just for the fun of creating weird monstrosities. It is the business of science to investigate and interpret nature and not to be amusing. Horrible creatures enough will be evolved. But they will teach lessons, point to new avenues of inquiry, reveal ever new ways of fitting together the pieces of life's jigsaw puzzle. To what end? The elevation of man. Like any other creature, he evolves. In fact he is one of the most unstable species of animals alive. Whither is he drifting? There is no answer yet. But there will be when the experimental evolutionists put synthetic life through its paces.

There is direction in evolution. Suppose that with the knowledge gained by making and studying synthetic cells it becomes possible to compel a primitive creature to change the direction that nature would have it take. Science will then begin, in a sense, to design forms of life. Man will be able to reshape himself. What if it will take more time in centuries than I care to set down, even with all the accelerating devices still to be discovered and invented? Man consciously and deliberately reaching out beyond his present self, planning what he wants to be physically and mentally, willing to throw himself on the scrapheap of evolution and mingle his bones with those of the countless fish, reptiles, and birds that nature herself discarded, bending chemistry and physics in the effort to emerge from the chrysalis in which he is now encased—that is the ultimate meaning of Professor Haskell's synthetic cell and its power of evolving into something higher.

Classroom Ideas

General—Biology

Scientific Art

By ROBERT D. MacCURDY, Biology Instructor
and
PAUL O'CONNELL, Student Chairman of Chart Exhibit
The Senior High School, Watertown, Massachusetts

Visual aids can make the job of science teaching much easier. That is why, for the past seven years, students at Watertown High School have been making charts to show some phase of their biology course. The charts they make are used in class to clarify the science principles involved. When the Future Scientists of America Foundation announced the 1954 science chart contest, it was an opportunity for the students to receive more than credit in class. It was a chance for prize money and national recognition as well.

In December of 1953, the students started preparing the charts. Around the middle of January, 1954, the charts began to trickle in, so a storage space was set aside for them in one of the cabinets. We soon realized that this was not satisfactory, because curious students were continually poking into it to look at the work. The instructor in the biology course approached one of his students and asked him to arrange to have the charts set up some place where anyone who wished to could see them. They chose a date and a time to have the charts on exhibition. Then, to provide special interest, they decided to issue ballots and have everyone who came to the exhibition vote for the chart that they liked best. On February 17, during the first lunch period and continuing until half an hour after the close of school, the charts were on display in the school library. The four Boston newspapers were contacted. One responded by sending a photographer, resulting in a five-column picture in the paper the next morning. The local papers were also called and one responded by printing a picture of the girl whose chart was voted best with a story written by the chairman of the exhibit. This was used as the lead story in the paper the next day.

There were 33 charts in our exhibition, and over 300 people came to vote. The winning chart by popular vote was "Life Cycle of a True Fern" entered by June Macurdy. The chart entered by Marjorie Blyth, "Osmosis—What Is It?" won fifth place in the popular vote. These two girls were the only two winners from New England in the FSA national contest. Eight out of the 40 finalists in the national contest were from our school. We think our students did very well indeed, and that the local exhibition was a big factor in the success of the program.

Paul O'Connell later did a study of motivation and interest preference of students in the science fair and the chart contest as opposed to non-participants. He wanted to discover why only girls enter the chart contest in great number. The results to date of an incomplete report indicate that the girls in the chart contest are more interested in public speaking, sculpturing, inventing things, science studies on projects, collecting stamps and coins, museum study and work, and playing chess than are the non-participants, who prefer playing sports, dancing, boating for pleasure, rather than the other items. The survey, when complete, will show the average interests of girls and boys in each of 62 items and their reasons for entering (or not) the science activities. With this study we hope to be able to integrate the extra-curricular activities of science students into their science course.

EDITOR'S NOTE: *Announcement of the 1955 science chart contest for students will appear in an early Packet.*

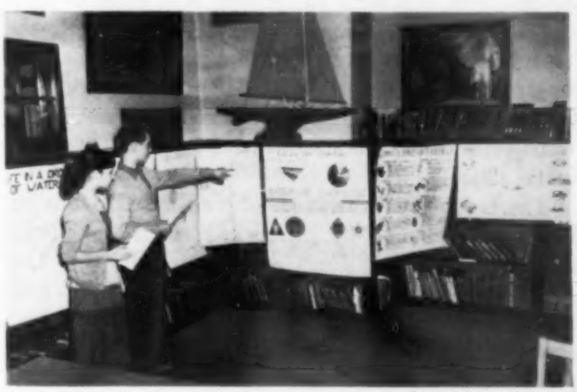


PHOTO BY BOSTON POST

A general view of the Student Chart Exhibit, Watertown, Massachusetts, High School.

General Science, Physics

A Use for 'Old' Iron Filings

By FRANK E. WOLF, Fulbright Science Teacher, Bassein, Burma

Most teachers are familiar with the materials used to show the presence of a magnetic field—a magnet and iron filings. These materials may be used in a new way to provide for the exercise of some of the elements of reflective thinking and the development of some of the scientific attitudes.

Iron filings which have been used frequently in contact with magnets tend to become magnetized. Magnetized iron filings are of course unsuitable for a demonstration of magnetic fields. However, as a prelude to the teaching of magnetic fields, the teacher may use 'old' iron filings to lead the class through what usually results in a rather lively experiment.

The teacher presents to his class an iron bar shaped and painted to resemble a bar magnet, and a container of 'old' iron filings known to be magnetized. Some members of the class will immediately and mistakenly assume that the iron bar is a magnet. This will be especially so if they have been introduced to the day's activity by a thoughtful preparatory lesson.

The iron bar is thrust into the container of 'old' iron filings and withdrawn. Some of the filings will cling to the iron bar. The teacher asks his students to state what they saw and then to present their hypotheses. One hypothesis is sure to be that the "magnet" attracted the filings.

The teacher then reaches into his pocket for a house or car key and thrusts it into the filings. The key will likewise emerge with iron filings clinging to it. The teacher's expression will usually elicit from a skeptic in the class the hypothesis that the teacher magnetized the key in advance. This may be noted as an assumption. The teacher inquires how the class can determine whether this is so. Usually another student will suggest testing other metal objects.

The teacher uses next an offered metal bobby or hair pin. The bobby pin is placed in the filings and withdrawn. Filings adhere to it, too. The teacher asks for explanations and is usually told that the electricity in the student's hair magnetized the bobby pin. The reader can see where an exploration of this statement might lead. The teacher then uses another object offered by the class, such as a nail. This eliminates the variable introduced with the bobby pin demonstration (hair-electricity magnetizing the pin).

At this point it will seem obvious to the class that the bar is not a magnet and/or the filings are magnetized. The teacher asks the class how to test these hypotheses. By carefully inciting the class the teacher can motivate them to take sides, one for each of these possibilities, and to devise their own experiments which will determine which hypothesis is valid.

After the class has presented its evidence the teacher may refer to the assumption previously made that the car key was magnetized in advance. He asks the class if the fact that iron filings cling to the non-magnetized nail is sufficient proof that the key is not magnetized. This illustrates the fallacy of accepting this sort of "proof", i.e., the key could have been magnetized despite this proof. In addition, the teacher may discuss the reasons for *noting* the assumption that the car key was magnetized in advance, and for *eliminating* the possibility of a variable.

The teacher may now use a bar magnet and the same 'old' filings to show that while the first metal bar was not a magnet the class could not conclude that it was not a magnet without further evidence. All that could have been said was that the filings

were magnetized. The class could not say that the bar was not a magnet until it had been tested. Finally, the actual demonstration of magnetic fields may be performed.

In conclusion, attention may be drawn to the elements of scientific method which were particularly useful in solving the problem, the safeguards to critical thinking which were employed, and the scientific attitudes which helped lead to the solution of the problem. The knowledge objectives of this exercise are obvious. An important applied knowledge would be that watches remaining in contact with magnets or in magnetic fields may become magnetized. This might lead to the attainment of the behavior objective that students will keep their watches away from magnets or magnetic fields. The development of important skills would be achieved in the experiments which the students set up to determine the validity of their hypotheses.

These events have been written as they occurred. It may be necessary to shift the preconceived plan to capitalize on different classroom situations. It is a great source of enjoyment to take advantage of the class reaction by questioning the class in a manner intended to lead in the general direction planned.

Elementary Science

WATER, WATER EVERYWHERE—

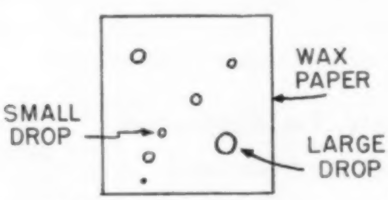
By HARRY MILGROM

Supervisor of Elementary Science
New York City Board of Education, Brooklyn

A drop of water can be used to fire the imaginations of children at every grade level and set them off on a lively, fruitful adventure.

At an appropriate time, when the children become aware of the need to learn more about water, they can, individually and as a group, explore many of its characteristics.

Give *each* child a three-inch square of wax paper with a few drops of water scattered upon it. Use a medicine dropper to distribute large and small drops.



Get the children started by suggesting that they:

1. Examine the wonderful shape of a drop of water. Will it take this shape on a piece of ordinary paper? Why not? How does the shape of a large drop compare with that of a small one? Why are they different?
2. Notice how a drop glistens like a moonstone. Will a drop of red ink look like a ruby? Green ink like an emerald? Black ink like a black onyx?
3. Push small drops together and watch them merge. Is this how drops of water in a cloud grow larger and larger, until they are heavy enough to fall as rain?
4. Hold the wax paper vertically. Do the small drops roll down? Do the large drops roll down? How is this related to clouds and rainfall?
5. Touch a drop with the tip of a pencil. Does it seem to come alive as it wets and crawls up on the pencil? What other things does it wet?
6. Poke a drop with the pointed tip of a small birthday candle. Does the drop seem to have a "skin" that cannot be penetrated? Do water insects have a waxlike coating on their legs which keeps them from pushing through the water? Is that why they can walk on the surface of a pond? Are there other things which the drop will not wet?
7. Place the tip of a pencil in contact with one part of a drop and then move the pencil. Does the drop stretch out and follow the pencil? Does the drop seem to hold itself together?
8. Touch a colored drop with a piece of paper towel or blotter. Does the color spread rapidly up into the paper? Is this how water spreads in soil to reach the roots of plants? Is this why a blotter blots or a towel drys? Which would be a better material for a raincoat, the paper towel or the wax paper? Why?
9. Place a speck of soap or detergent powder on a drop. What happens to the drop? Does it now wet the wax paper? Is this why the combination of soap and water is better able to wet and remove grease from soiled hands and dirty dishes than water alone?
10. Place the wax paper on a printed page. Look at the letters through the clear drops. Do the drops magnify the letters? Do the large drops magnify more or less than the small ones?
11. Touch the top of a drop with the tip of a fountain pen. Does it leave a speck of ink on the drop? How many separate specks can you place on the drop? Can you make a speck picture of a face on the drop?
12. Leave a colored drop of water on the wax paper overnight. What do you find the next day? What happened to the water? What happened to the color?

These are just a few of the findings of children and teachers as they use this "science equipment." Introduce your children to these little drops of water and share with them the thrill of discovery.

NSTA Activities

Berkeley Meeting

December 27-29
University of California, Berkeley

The 1954 winter conference for all science teachers which is held in conjunction with the annual meeting of the American Association for the Advancement of Science will provide the usual dynamic program of NSTA meetings. It will appeal to all fields of interest and levels of instruction.

The program has been arranged by the chairman, NSTA President-elect STOLLBERG, with the assistance of his Advisory Committee from eight western states. The following individuals have arranged for major sessions of the program: GERTRUDE CAVINS, San Jose State College, San Jose, California; CHARLES E. BURLESON, San Francisco State College, San Francisco, California; PAUL HURD, Stanford University, Stanford, California; JEANIE NIERI, Meadow Heights School, San Mateo, California. The Wednesday morning program, December 29, has been planned by the sponsoring groups, NSTA, NARST, Section Q (Education) of the AAAS, the Cooperative Committee of the AAAS, and the Western Society of Naturalists.

Other attractions for science teachers are the meetings of the National Association of Biology Teachers and the American Nature Study Society, and the significant program planned by the Cooperative Committee on the Teaching of Science and Mathematics. On Tuesday afternoon, December 28, the AAAS Junior Scientists Assembly will be held on the campus of San Francisco State College. This event is exclusively for high school students in the Bay Area.

Arrangements for rooms on the campus should be made with the AAAS Housing Bureau, 2223 Fulton Street, Berkeley, California. *Make reservations early.* Meals will be available at campus cafeterias. For further information about the meeting write to Dr. Robert Stollberg, San Francisco State College, San Francisco, California.

Program

Monday, December 27

9:00 A.M. General Session. Wheeler Auditorium.
Presiding—GERTRUDE CAVINS, San Jose State College, California.
KEYNOTE ADDRESS: "The Schools, Their Problems, and You"; WILLIAM G. SWEENEY, San Jose State College, California.

10:15 A.M. "Town Meeting" Discussions of Address.
Concurrent Session 1; Kindergarten through Grade 6. Wheeler 11.
Presiding—CARL DUNCAN, San Jose State College, California.
Concurrent Session 2; Grades 7 through 9. Wheeler 30.
Presiding—ARCHIE MACLEAN, Los Angeles City Schools, California.
Concurrent Session 3; Grades 10 through 12. Wheeler 110.
Presiding—JOHN MEISCHKE, Campbell Union High School, California.

11:45 A.M. Luncheon Program; "This Is Your NSTA". Turquoise Room, Campus Cafeteria.
Presiding—WALTER S. LAPP, President of NSTA.

1:30 P.M. Keeping Up To Date In Science.
Concurrent Session 1. Wheeler 30.
Presiding—STANLEY W. MORSE, San Francisco State College, California.
"Practical Power From The Atom"; DAROL FROMAN, Los Alamos Scientific Laboratory, New Mexico. "Genetics of Grasses"; JOHN MADISON, College of Agriculture, University of California, Davis. "Petroleum Chemistry"; T. W. EVANS, Shell Development Company, Emeryville, Calif.
Concurrent Session 2. Wheeler 110.
Presiding—H. M. LOUDERBACK, Lewis and Clark High School, Spokane, Washington.
"Understanding the Basis for Heart Attacks"; JOHN W. GOFMAN, Donner Laboratory, University of California, Berkeley.
"Recent Advances in Virus Research"; HAROLD N. JOHNSON, Division of Medicine and Public Health, Rockefeller Foundation.
"Meteorology"; JOHN LEIGHLY, Department of Geography, University of California.
Concurrent Session 3. Wheeler 120.
Presiding—BLANCHE BOBBITT, Los Angeles City Schools, California.
"Recent Advances in Earth Sciences"; ROBERT W. WEBB, University of California, Santa Barbara.
"Jets and Rockets"; Daniel Wentz III, Ames Laboratory, Moffett Field, California.
"Smog"; DALE HUTCHINSON, Stanford Research Institute, California.

4:00-6:00 P.M. Social Mixer. Women's Social Room, Stephens Union. *Hosts*—Elementary School Science Association of Northern California.

Tuesday, December 28

9:00 A.M. General Session. Wheeler Auditorium.
Presiding—PAUL HURD, Stanford University, California.
KEYNOTE ADDRESS: "Science Teachers Face Their Problems"; JOHN S. RICHARDSON, Ohio State University, Columbus.

9:50 A.M. Trends and Issues in Science Teaching.
Concurrent Session 1; Kindergarten through Grade 6. Wheeler 110.
Presiding—AGATHA HOGAN, San Francisco Public Schools, California.
Speaker—JEFF WEST, Stockton Unified School District, California.
Concurrent Session 2; Wheeler 200. Grades 7 through 9.
Presiding—RAMONA GALENO, Presidio Junior High School, San Francisco, California.
Speaker—DONALD W. STOTLER, Portland Public Schools, Oregon.
Concurrent Session 3; Wheeler 120. Grades 10 through 12.
Presiding—JOHN H. MAREAN, Reno High School, Nevada.
Speaker—ADRIAN GENTRY, San Diego County Schools, California.

11:00 A.M. Concurrent Session 1; Symposium: "My Best Teaching Unit". Elementary and Junior High School Science. Wheeler 110.
Presiding—J. MARTIN WEBER, Sacramento County Schools, California.
Speakers—FLORENCE DURFEE, Lincoln Glenn Elementary School, San Jose, California. MARIE GREEN, David Starr Jordan Junior High School, Palo Alto, California. ROBERT B. LEITCH, Lincoln Junior High School, Santa Monica, California. ALPHA H. FIFER, Carson City Public Schools, Nevada. ROBERT CAMPBELL, James Denman Junior High School, San Francisco, California. JOHN HARLAN, Horace Mann Junior High School, San Francisco, California.
Concurrent Session 2; Symposium: "My Best Teaching Unit." Senior High School Science. Wheeler 200.
Presiding—REBECCA BRINCKERHOFF, Castlemont Senior High School, Oakland, California.
Speakers—FERN JOHNSON, Santa Barbara High School, California. HAROLD ZIMMERMAN, Polytechnic High School, San Francisco, California. CHARLES S. MIGLIAZZO, Huntington Park High School, California. WILLIAM F. DREZIA, San Rafael High School, California. CARMELITA BARQUEST, South Salem High School, Salem, Oregon.
Concurrent Session 3; The Science Teachers' Clinic —"Bring Your Problem". Wheeler 120.
Presiding—WALDEMAR E. DOYAL, C. K. McClatchy High School, Sacramento, California.

1:30 P.M. General Session. Wheeler Auditorium. High School Student Panel: "Science, Science Classes, and Science Teachers".

Presiding—THOLBERT HONEA, Pittsburg Senior High School, California.

Moderator—JOHN W. MEISCHKE, Campbell Union High School, California.

2:30 P.M. Persistent Problems of Science Teachers. Concurrent Session 1; Superior Students in Science. Wheeler 30.

Presiding—ALBERT HEPPE, Sonoma High School, California.

"Providing for the Superior Student"; JOHN CAFFREY, Los Angeles County Schools, California.

"Science Projects for the Superior Student"; FRANCIS ST. LAWRENCE, Lindbergh Junior High School, Long Beach, California.

Concurrent Session 2; Outside Resources in Science Teaching. Wheeler 110.

Presiding—DAVID PROBERT, Vallejo Evening College, California.

"Outdoor Explorers"; WELDON PARKER, Scott Lane School, Santa Clara, California.

"The Junior Academy of Science"; GRETCHEN SILBEY, Los Angeles County Museum, California.

"Science on Television"; BENJAMIN DRAPER, Executive Producer, "Science in Action", KRON-TV, San Francisco, California.

"Industry-Sponsored Teaching Materials"; A. J. McNAY, Standard Oil Company of California, San Francisco.

"The Junior Museum"; JOHN R. FORBES, Director, National Foundation for Junior Museums, Inc., Sacramento, California.

Concurrent Session 3; Teaching for Problem-Solving. Wheeler 120.

Presiding—RICHARD DATE, Balboa High School, San Francisco, California.

"Group Process in Problem Solving"; HILDA TABA, San Francisco State College, California.

"Recent Studies in Problem Solving"; DONALD W. TAYLOR, Stanford University, California.

"The Science Teacher and Problem Solving"; OREON KEESLAR, Santa Clara County Schools, California.

8:00 P.M. AASA Presidential Address. Wheeler Hall Auditorium.

Wednesday, December 29

(This program is jointly sponsored by the National Science Teachers Association, National Association for Research in Science Teaching, AAAS Section Q, AAAS Cooperative Committee on the Teaching of Science and Mathematics and the Western Society of Naturalists.)

9:00 A.M. Symposium: Research in Science Teaching. Wheeler Auditorium.

Presiding—ANITA D. LATON, San Jose State College, California.

"Survey of Research in Elementary School Science Education"; JACQUELINE BUCK, Grosse Pointe Public Schools, Michigan.

"Implications of Research in Elementary School Science Education"; MATTHEW VESSEL, San Jose State College, California.

"Survey of Research in Secondary School Science Education"; GEORGE G. MALLINSON, Western Michigan College of Education, Kalamazoo.

"Implications of Research in Secondary School Science Education"; OREON KEESLAR, Santa Clara County Schools, California.

"Survey of Research in College Level General Education Science"; STANLEY WILLIAMSON, Oregon State College, Corvallis.

"Implications of Research in College Level General Education Science"; JOHN S. HENSILL, San Francisco State College, California.

12:00-2:00 P.M. "Try It Yourself" Exhibits. Wheeler 230.

Arranged by—ROBERT SCHMIDT, Palo Alto High School, California.

2:00 P.M. General Session. Progress in Science Education. Wheeler Auditorium.

Presiding—JEANIE NIERI, Meadow Heights School, San Mateo, California.

Speaker—EDNA W. BAILEY, (Emeritus), University of California, Berkeley.

2:30 P.M. "Here's How I Do It".

Concurrent Session 1; Kindergarten through Grade 2. Wheeler 110.

Presiding—MARY DURKIN, Contra Costa County Schools, California.

Concurrent Session 2; Grades 3 through 6. Wheeler 120.

Presiding—HERBERT WONG, Franklin School, Oakland, California.

Concurrent Session 3; Grades 7 through 9. Wheeler 200.

Presiding—WILLIAM C. CAMPBELL, Horace Mann Junior High School, San Francisco, California.

Concurrent Session 4; High School Biology. Wheeler 210.

Presiding—MATTHEW VESSEL, San Jose State College, California.

Concurrent Session 5; High School Chemistry. Wheeler 213.

Presiding—THOMAS POULSON, University of California, Berkeley.

Concurrent Session 6; High School Physics. Wheeler 122.

Presiding—ROBERT B. TODD, Oakland Public Schools, California.

4:00-6:00 P.M. "Try It Yourself" Exhibits. Wheeler 230.

FSA Activities

Science Achievement Awards For Students

Where can busy teachers get ideas to pass on to their students who want to do science projects? *Encouraging Future Scientists: Student Projects* may help. The new laboratory exercises which were developed by the West Coast Science Teachers Summer Conference suggest several ideas. Here are some more of the kinds of questions which may spark a worthwhile student project.

1. What kind of metal will take the best enamel coating?
2. What does repeated bending do to metal wires?
3. How does the strength of an empty metal tube compare with a similar tube with a concrete or wood core?
4. Does roughening a metal surface improve its paint holding properties?
5. How can ordinary nails be treated so they will drive into concrete or cinder blocks?
6. Is there a metal container which will retard the souring of milk?
7. How can the bright work on autos be protected from de-icing salt corrosion?
8. Does heat-treating of metals affect the electrical conductivity?
9. How can additional silver be plated on the worn spots of silverware?
10. Does the one-hundredth bending of metal strips require the same effort as the first bend?
11. Can metal cones or filaments be used to measure the maximum temperature in a blacksmith's forge or welding torch?
12. How many different chlorides or nitrates can be prepared from samples of discarded metallic objects around the home?
13. What is the minimum concentration of an antifreeze that, upon freezing, will fail to burst a tin or paper container?
14. Is the quality of sound produced by strings, reeds, pipes, or bells dependent upon the kind of metal involved?
15. Are there substances which, when mixed with weed killers, will increase their effectiveness?
16. Is the susceptibility of plants to insect infestation related to the absence or presence of soil nutrients?
17. Is flower color affected by soil components?
18. What is the probability that a seedling will appear at the maximum distance wind-blown seeds are scattered from a parent tree?
19. How accurately can the number of seeds produced by a tree or shrub be estimated?
20. Will grass that has been closely clipped survive dry spells as well as less closely cut grass?
21. What are the maximum and minimum temperatures which seeds can survive?
22. Can the airplane ball-bank indicator be adapted to warn auto drivers of excessive speed on turns or curves?
23. Can flash bulbs be appropriately coated or made of colored materials to provide built-in filter effects?
24. Can the entrance to basin or tub drains be redesigned so as to speed up draining rate by eliminating the hole in the whirlpool?
25. Is the number of practice exercises that a student does related to his score on an examination?
26. How do the properties of a water stream compare with those of an airflow?
27. Do discharged wastes from public and private sewers kill fish?
28. Will tobacco virus affect other plant species?
29. Does a constant flow of electrical current through soil affect plant growth?
30. Will light, sound, or electrical discharges divert fish along a desired path?

FSA Student Chart Making Contest

Right now is a good time to encourage students to begin the design and construction of science teaching charts so they can enter them in this 1955 activity.

Recognition Awards for Science Teachers

Quoting Rule 1 from the "What and Why" of this program: "Write up your experiences in recognizing, studying, and coping with a science and/or math teaching problem or experience," one can see that almost any kind of topic can be used as the basis of an entry in this program. Although it will not affect the judging of the entries, teachers are being especially encouraged to report their new ideas for:

1. Up-to-date laboratory exercises.
2. Diverting students away from "cook-book" procedures in the laboratory.
3. Relating school laboratory exercises to what is going on in industrial, university, and government laboratories.
4. Laboratory exercises which clearly and honestly introduce students to the genuine strategy of experimental inquiry.

Volume XXI, THE SCIENCE TEACHER

Index—February through November, 1954

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Education of Science Teachers

Elementary School Science

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Investigations, Research, and Fact-finding Studies

NSTA Activities

Science Clubs, Fairs, Exhibits; Science Talent Searches

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ENCOURAGING FUTURE SCIENTISTS: Student Projects. What kinds of projects can students do? How should projects be reported? Rewards and recognition for projects. (Single copies 50¢; in quantities of two or more, 25¢.)

ENCOURAGING FUTURE SCIENTISTS: Materials and Services Available in 1954-55. A bibliography listing student awards and incentives; career information and guidance materials; and other kinds of services useful in working with science students. Revised edition of earlier booklet prepared by NSTA's Future Scientists of America Foundation. (Single copies 50¢; in quantities of two or more, 25¢.)

FREE ON REQUEST

CAREERS IN SCIENCE TEACHING. A new career information booklet. Developed as a project of the Future Scientists of America Foundation. Designed for guidance use with students in high schools and colleges.

NSTA BEST-SELLERS

SCIENCE IN SECONDARY SCHOOLS TODAY. About forty contributors present their views on science teaching trends, perplexing problems, and promising practices. One of the "landmarks" in recent science education literature. Used as the text in many college courses for science teachers. ($1.50.)

SELECTED SCIENCE TEACHING IDEAS OF 1952. Fifteen unusually good science teaching ideas as reported by teachers in the 1952 program of Recognition Awards for Science Teachers sponsored by the American Society for Metals. *The supply of this publication is running low.* ($1.50; $1.00 to NSTA members.)

SCIENCE TEACHING TODAY—Vols. I-VII. Booklets of demonstrations, experiments, and student projects for use in grades 3 or 4 through 9. Separate titles include: water; air; fuels and fire; heat; magnetism and electricity; sound; light and color. (Each title 75¢; $4.50 for the set of seven.)

REVISED BIBLIOGRAPHIES

BIBLIOGRAPHY OF SCIENCE REFERENCE AND TEXTBOOKS. List of books for elementary science, junior high science, general science, biology, physics, chemistry, general physical science (senior science), earth science. (50¢.)

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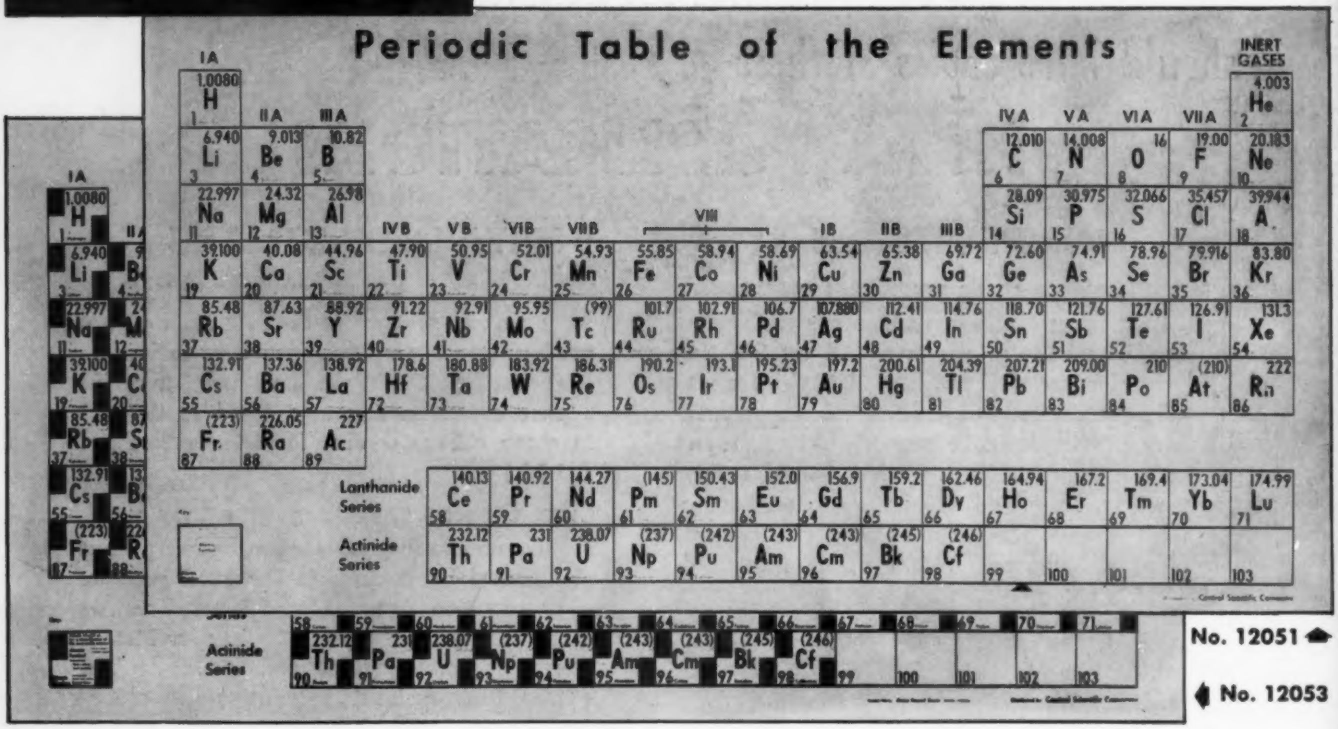

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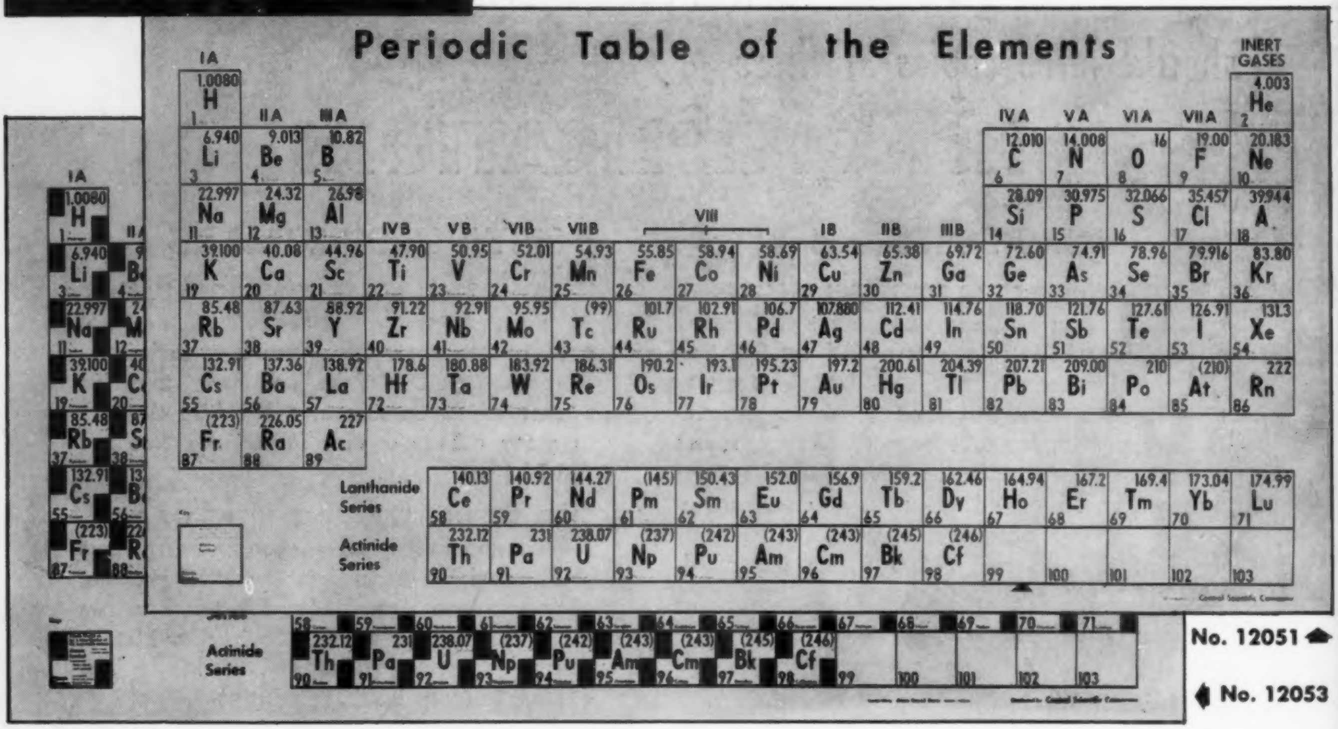

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